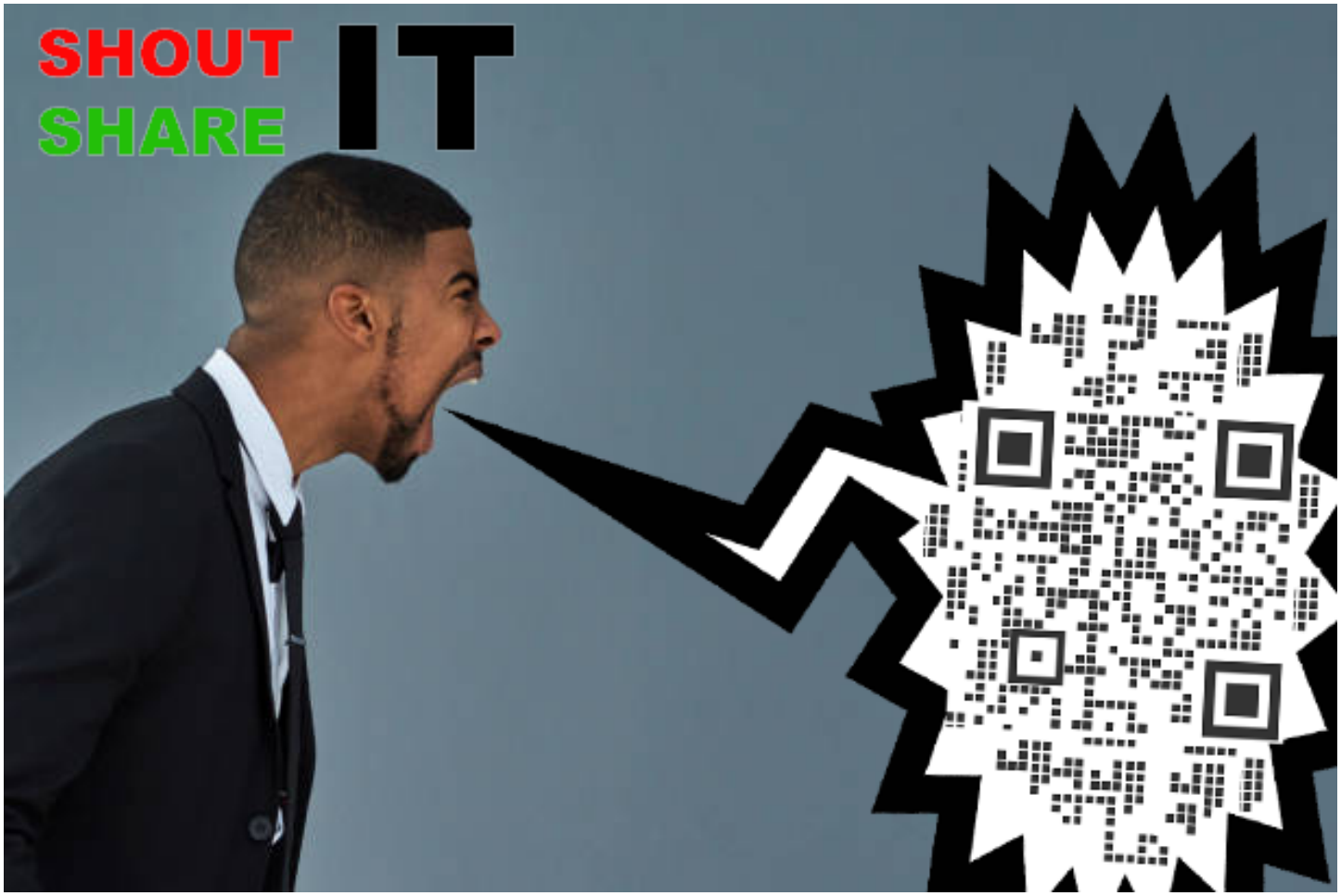
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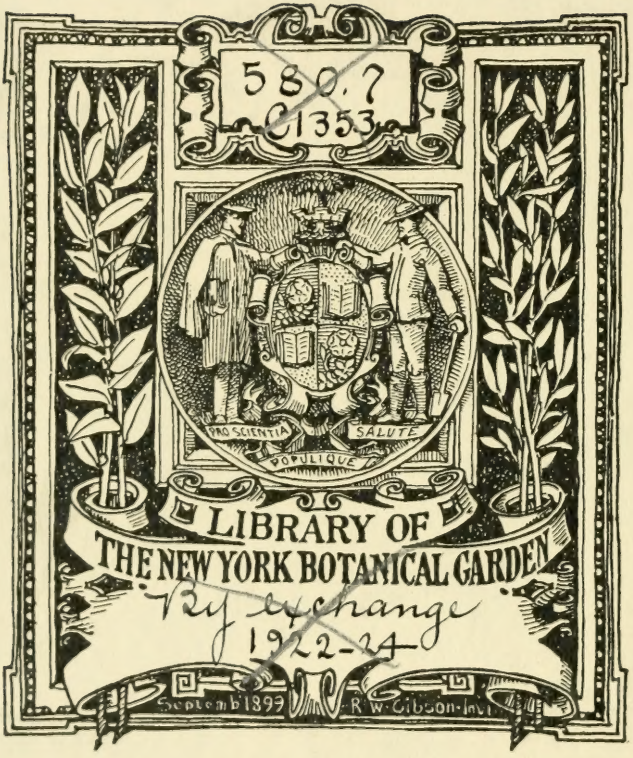
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THE GENUS FUCUS ON THE PACIFIC COAST OF NORTH AMERICA

BY

NATHANIEL LYON GARDNER

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NATHANIEL LYON GARDNER

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INTRODUCTION

The genus *Fucus*, although among the earliest established genera of algae, having been studied on the Atlantic and Arctic coasts of Europe by most of the algologists since the days of Linnaeus, is, nevertheless, even today, a genus in which the limits of the species, not only in European waters but also in those of Asia and America, have not been clearly defined. The flattened, more or less flabellate and mostly dichotomously branched fronds, together with the very constant character of the formation of eight viable eggs in oögonia borne in cavities in the modified ends of the fronds, quite definitely delimit the genus from all other genera of algae; but the discovery of single characters, or combinations of characters, sufficiently stable to serve in delimiting the multitude of species and forms has been a matter much more difficult of attainment. About twenty-five species and over forty varieties and forms have been previously proposed. From time to time species have been reduced to varieties and to forms, and these have in turn been raised to the rank of species, and the species have been interchanged, according to the conceptions of the different investigators of the group. This has gone on with increasing complexity and there seems never to have been a time when more confusion existed in regard to the disposition of the *Fucus* flora, particularly that of the Atlantic and of the Arctic waters, than the present. The confusion is due to a variety of causes. One of the chief difficulties one encounters in trying to get an understanding of the conceptions of the early writers concerning certain species is the incompleteness of the descriptions, adequate at the time to distinguish fairly well the few forms then known, but wholly inadequate to serve in the separation of species as limited by present day usage. Coupled with the brevity of the descriptions, one often encounters an added difficulty in the nature of poorly prepared, and for the most part, fragmentary specimens preserved as types, if indeed any at all have been preserved. I have quoted some of these early descriptions under proper headings, and have also presented illustrations of some of the few type specimens, which will serve, in some degree, to show the existing state of affairs.

Since the days of Linnaeus our conceptions of species have been and still are changing. Formerly larger units were grouped under a single concept, and a few words were sufficient to embody the concept. The general tendency has been to break up the larger units, assigning

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to each kind fewer and fewer characters. Today, with the coming of the geneticist, the concept of a species is becoming so limited that for practical purposes, if carried to the extreme, it has but little value; nevertheless it cannot be ignored. It is now generally conceded that new kinds of organisms have arisen, and are still arising through permanent modifications appearing in the offspring which produce an individual more or less different from the parent, and that these modifications are heritable and stable. The causes of the modifications that bring about such changes have not yet been assigned. According to Darwin, the modifications are small and when the succession of infinitesimally small modifications in the suppression or development of a structure has proceeded long enough the offspring becomes a species. According to De Vries, the modifications may be relatively great, so that one may readily detect the difference between the parent and the offspring in a single generation. The offspring becomes a new species at once. Possibly both these ideas are correct, but in some groups of individuals constituting entities, the forces acting to bring about the changes operate slowly, whereas in others they are accelerated and the resulting changes are marked at once. In either case, it is left to the keenness of the observer to detect the differences. And the difficulty does not end with that; it can not, in the nature of things, until a specific standard is set up and agreed upon. Darwin never suggested by how much one group should differ from another in order to constitute a species.

Another complicating set of factors always enters into the situation in a rapidly changing, or species making group, to further the difficulty of detecting the limits of species. The individuals of every generation of all groups of organisms may vary in one or more morphological characters, but these differences are not heritable. This is spoken of as *fluctuating variation*. The problem which one usually has to determine in placing an individual is whether the dominant character or characters is due to fluctuating variation or to a change which has become fixed. The fluctuating variation may often be much greater than the permanent difference between two species. Thus the average width of the fronds of a species of *Fucus* (*a*) may be 10 cm., and that of another (*b*) may be 15 cm. Some individuals in (*a*) may possibly be wider than 15 cm. and some in (*b*) may be narrower than 10 cm.

The causes of the differences in characters in fluctuating variation may be grouped under two categories, one physiological and the other environmental. For example, two *Fucus* plants of the same lineage may have equal environmental conditions and be equal in initial size,

but be decidedly different at maturity in a particular character or characters, the differences being due to causes physiological and not yet explainable, and the deviation from the normal not be heritable. Again two plants of the same lineage may by chance get started in different habitats in the same locality and at maturity be quite unlike, e.g., in size, one typical of the species growing in a belt of optimum conditions for that species, and the other a dwarf merely, due to being removed from such a belt of optimum growth.

In passing I may say that the belt of optimum growth is not the same for all species of *Fucus*. Some species or forms thrive only in the extreme lower littoral belt, others in the middle, and still others in the narrow belt along the extreme high-tide limit. It cannot be argued that the species along the extreme high-tide limit are necessarily there by chance and represent dwarf specimens. *Fucus evanescens* f. *robustus* may be found in such a belt extending along the coast for miles where no other species or specimens exist, and yet the rock ledges in such localities are continuous from far above the high-tide limit to below the low-tide limit. Specimens of any species may, however, be stranded in the upper tide limits, e.g., on mud flats, and may leave offspring which may develop into seemingly distinct forms. I have seen this demonstrated to my entire satisfaction in the case of the so-called *nanus* forms. These forms are merely transitory. I have seen acres of territory bearing such plants of any species that happened to be growing in the vicinity, the most of which never come to the fruiting period and are always more or less, usually profoundly, distorted and dwarfed. Thus it is quite essential to know the habitat of a plant when attempting to place it.

In this paper I am describing three new forms of *Fucus* seemingly quite distinct from each other genetically, and apparently distinct from all other entities, but which possibly may be only environmental forms. They all fruit abundantly and, to all appearances, from observations made during only one season, they perpetuate themselves and remain constant. These are forma *cuneatus*, forma *depauperatus*, and forma *oregonensis* of *Fucus evanescens*, found growing in Coos Bay, Oregon. They are profoundly different in shape, size, and color from any forms growing outside of the mouth of Coos Bay. A strong tide sets into the bay and floating specimens may be readily carried for miles in either direction. The determination of the lineage of such forms constitutes a real problem which, in each case, wherever it may arise, can only be solved by experimentation. In a place like Coos Bay, the demonstration could fairly easily be made.

For many years I have observed, in their native habitats, extensive beds of *Fucus* growing on our western shores extending from central California to Sitka, Alaska, and have been much confused and deeply perplexed in trying to determine the best disposition to make of the multitude of forms here represented. The range for the genus extends from Oil Port, San Luis Obispo County, California, its southern limit as at present known, into the Arctic Ocean, and is practically unbroken. In the southern portion of the range the problem is comparatively simple, there being but few forms represented. The complexity increases northward, and the optimum for luxuriance in growth of numbers of forms and of individuals seems to be in the general latitude of Sitka, Alaska.

I have come to the conclusion that we have in this genus an example of extreme plasticity, in which the forces at work breaking up continuity are vigorously active. Plants with new combinations of characters are arising and, to still further complicate the matter, these probably hybridize with one another.

For ultra popular usage, a very few species, perhaps four, would thoroughly suffice to include all of the forms of the genus, e.g., *F. serratus*, *F. vesiculosus*, *F. spiralis*, and *F. evanescens*. Morphologically *serratus* is obviously distinct, *vesiculosus* is always dioicous, while all others are synoicous. Forms which have been included even under *spiralis* and *evanescens* might be confused because of overlapping characters. Such a disposition would doubtless, for scientific usage, meet with hearty disapproval. On account of the nature of the genus, any disposition at present can only be approximate in the face of our vastly incomplete knowledge concerning a variety of points.

Without further delay, I am arranging our multitude of forms under five rather comprehensive species, viz., *F. furcatus* Ag., *F. nitens* nob., *F. edentatus* De la Pyl., *F. membranaceus* nob., and *F. evanescens* Ag. These I have so diagnosed as to make them include all the forms which I have grouped around them, and have designated the group as *species major*. Under each *species major*, respectively, I have grouped 13, 0, 5, 6, and 21 forms which I feel quite convinced are entities, giving rise to others of their kind in successive generations in the same manner as does any other species; however, my investigations may not have been extensive enough as yet to prove this statement. These forms I am designating as *species minor* and, following customary usage, I am calling them *formae* of the respective species, awaiting further investigation and experimentation to prove the

validity of their specific rank, or that they represent merely individuals with inconstant and fluctuating characters, due to environmental influences.

Historical Review

Kjellman (1883, p. 203) remarks as follows concerning some of the numerous forms which he has described:

> I have set down here the same forms that I have before endeavored to distinguish and to define. They are certainly connected by numerous intermediate forms, but they deserve, however, to be mentioned specially, because they show the limits and directions of the variations of the species and differ somewhat with regard to biology and geographical distribution.

Yendo (1907, p. 16) has assembled several forms from the Japanese waters and has allied them, according to his conception, with certain of Kjellman's forms of *F. evanescens*, at the same time expressing his disbelief in ascribing definite identities to such plants: "Besides the above mentioned formae others might be pointed out. It would, however, be unimportant to add to algological literature more formal names, established on what I regard as invalid forms."

I find it not wholly a simple matter to justify the selection of the *species major* mentioned above as seemingly the most suitable to include our flora as against certain others which might have been selected. I also feel much handicapped in not having had direct contact with more European material for comparison. I have been compelled to rely largely upon descriptions.

Most of the earlier collections from our coast were assigned to European species. Two species, however, viz., *F. furcatus* Ag. (Sp. Alg., 1820, p. 97) and *F. evanescens* Ag. (*loc. cit.*, p. 92) have been described from the waters of the North Pacific, the former is said to have come from Unalaska and the latter from Kamtschatka. Agardh assigned these localities on the authority of Chamisso, who travelled along our coast in 1816 as far south as San Francisco. Some doubts have arisen as to the localities from which he obtained the material upon which Agardh based his species.

Harvey (Bot. Beechey, 1833, p. 163, and 1841?, p. 407) was apparently the first to accredit *F. furcatus* Ag. to the Pacific coast of North America. He based his judgment upon material collected at San Francisco, California, by Dr. Sinclair. I have not seen the specimen, nor have I any further information concerning it, but it seems quite probable, as may be seen later, that his determination was correct.

J. Agardh (1848, p. 209) quotes Chamisso's Unalaska specimen and Sinclair's San Francisco specimen under *F. furcatus* Ag., at the same time reducing *F. edentatus* De la Pyl. (1829, p. 84) to synonymy with *F. furcatus* Ag. This seems to have been the beginning of the confusion of the two species which has not, up to the present time, been completely cleared up.

Kuetzing (1849, p. 591) gives a brief diagnosis of the species as follows: "F. phycomate lineari enervi plano furcato, digitali; carpomatibus terminalibus planis 1–1½″ longis, phycomate latioribus." "Ad oras occidentales Americae borealis, ad Unalaschkam, Californiam." In Tabulae Phycologicae, 1860, plate 17, figure II, he gives a diagram of a portion of a plant from "Unalaschka" which shows the receptacles to be 3 to 4 cm. long and very sharply pointed. This figure was probably sketched from a portion of the type material collected by Chamisso and, although it differs considerably from Agardh's figure (Icon. Ined., pl. 14), it may well represent a more typical portion of a plant than Agardh's.

Ruprecht (1851, p. 346) has the following to say concerning *F. evanescens* Ag. and *F. furcatus* Ag., mentioned above:

> Ueber *Fucus evanescens* und *furcatus* kann ich jetzt, nach Einsicht der Original-Exemplare in Chamisso's Herbarium, ein sicheres Urtheil abgeben. Der erstere ist ein höchst unbedeutende, keineswegs beständige Form von *H. vesiculosa* und kommt nicht selten unter den Ochotskischen Exemplaren vor; die an den Fruchtzweigen verschwindende Blatt-Rippe bezeichnet diese Form am wenigsten; Chamisso's Pflanze stammt von Redowski, von der Westküste der Ochotskischen Meeres, nicht aus Kamtschatka.
>
> *Fucus furcatus* C. Ag. ist eine selbständige Art, wächst aber nicht bei Unalaschka, sondern in Nord-Californien bei Ross, woher ich neuerdings mehrere Exemplare sah. Von eben daher hat auch, nach meinem Dafürhalten, Chamisso seine Pflanze mitgebracht; die beigelegte Etiquette mit "Kamtsch?" bezeichnet, beweist, dass er selbst über ihren Fundort im Zweifel war.
>
> *Fucus furcatus* J. Ag. (Sp. Alg. I, p. 209) ist ein ganz andere Tang (eine Var. von *H. vesiculosa?*), als die gleichnamige, in den *Icon. Alg. ined.* Tab. 14 abgebildete Original-pflanze.

Harvey (1862, p. 163) again ascribes *F. furcatus* Ag. to the Pacific Coast in determining Lyall's collections from Vancouver Island. He remarks (*loc. cit.*): "My *F. Wrightii* from Japan scarcely differs. I fear that neither ought to be regarded as other than local varieties of *F. vesiculosus*, which sometimes, even in Europe, occurs with as narrow fronds. The elder Agardh's figure above quoted," that is, Icon. Ined., pl. 14, "is worthless as a guide to the species described by J. Agardh." *Fucus Wrightii* is now known to be a species of *Pelvetia*

(cf. Yendo, 1907, p. 20) which again leaves the status of *F. furcatus* in doubt so far as the Vancouver Island specimen is concerned.

These statements of Ruprecht concerning *F. furcatus* Ag. doubtless, as pointed out by Kjellman (1883, p. 205) and by Börgesen (1902, p. 465), influenced J. Agardh (1868, p. 40) to describe *F. furcatus* Ag. and *F. edentatus* De la Pyl. again as separate species. Kleen (1874, p. 29) subordinates *F. edentatus* De la Pyl. to *F. furcatus* Ag. Kjellman (1883, pp. 204, 205) takes up *F. edentatus* De la Pyl., accepting J. Agardh's latest interpretation (*loc. cit.*) of the distinctness of the two species and reduces Kleen's *F. furcatus* to synonymy, remarking in this connection:

> The identity of the *Fucus* in question (*F. furcatus*) occurring on the north coast of Norway, with *Fucus edentatus* De la Pyl. appears to me to be beyond a doubt. I have not, among the great number of specimens from Norway and the northeastern coast of North America examined by me found any that agree fully with Agardh's figure of *F. furcatus*. I have thought best to follow J. G. Agardh's later exposition, regarding *F. edentatus* as specifically distinct from *F. furcatus* Ag.

Börgesen (1902, p. 465) has made the following disposition of the *Fucus* forms on the Faeröe Islands. He, with Foslie (1886, p. 109) and Rosenvinge (1893, p. 834), takes up the *F. inflatus* (L.) Vahl (Fl. Dan., pl. 1127) as the species under which should be placed De la Pylaie's *F. edentatus*, and also reduces Kleen's *F. furcatus*, mentioned above, to synonymy with *F. inflatus*, as well as J. Agardh's *F. furcatus* to synonymy with *F. inflatus* f. *edentatus* (De la Pyl.) Rosenvinge.

Farlow (1881, p. 102) accredits *F. furcatus* to the New England coast, giving as further distribution, "Northern Europe; Arctic Ocean; North Pacific" and cites no. 108 in Farlow, Anderson, and Eaton's Algae Exsiccatae Americae Borealis. Again (1889, pp. 6, 7) he disposes of *F. furcatus* on the Atlantic coast in the following language:

> The *F. furcatus* of Marine Algae of New England is without doubt the same as *F. edentatus* of Newfoundland, formerly united with *F. furcatus* Ag., of the North Pacific, a species to which was also referred a *Fucus* of the northern coast of Norway. Later the two species were kept distinct by J. G. Agardh, and Kjellman in the Algae of the Arctic Sea referred the so-called *F. furcatus* of Norway and Greenland to *F. edentatus* where our common New England alga also belongs, although the *Fucus furcatus* of our west coast may perhaps be the same as the original *F. furcatus* of C. A. Agardh's Icon. Ined.

Acceptance of the ideas set forth by Foslie, Farlow, Rosenvinge, and Börgesen would quite effectively eliminate *F. furcatus* Ag. from the Atlantic and Arctic waters. It remains now either to reëstablish or to eliminate this species entirely. I propose to reëstablish it with

certain emendations, using as a basis for my decision Ruprecht's statements (*loc. cit.*) supported by Farlow's contention (*loc. cit.*) that *furcatus* belongs primarily to the Pacific coast of North America. Börgesen (1902, p. 465) recognizes the priority of Agardh's *furcatus* (1820) over De la Pylaie's *edentatus* (1829), but rejects the name *furcatus* on the ground, as he says, that "the specimen of this species which C. Agardh described was—judging especially from his figure—a small, poorly developed one (apparently a transitional form to f. *distichus*)." The type specimen of *F. furcatus* is in the Herbarium of J. G. Agardh, no. 00279 (Type!) Unalaska, Ex. Herb. C. Ag., according to Professor Setchell. I have reproduced Agardh's figure on plate 1, figure 1, and it certainly is not a characteristic portion of any species of *Fucus*, but represents, as I think, a proliferous portion of a plant. I have seen many specimens of proliferations similar to the one represented by Agardh (cf. plate 2), taken from dried herbarium specimens collected by Setchell at Fort Ross, the probable type locality. It seems to me that the evidence is sufficiently ample to warrant the assumption that Agardh's delineation, poor and uncertain as it is, refers to a plant on the California coast.

Basis of Classification

I am using as a fundamental distinguishing character of *F. furcatus* as a *species major* the presence, usually, of a large number of cavities in the fronds which are completely closed. These are, I suspect, what J. Agardh (1868, p. 38) refers to under "Cryptostomata immersa saepe numerosa, plurima diu clausa." I have investigated the origin of these structures and find that they originate as do the conceptacles and ordinary cryptostomata, as shown by Bower (1880). A surface cell near the growing point in the terminal depression breaks down and the cavity is formed as described by Bower, but unlike the conceptacles and the cryptostomata no ostiole remains. The cavity is completely arched over, and no paraphyses develop. This process appears to be an evolution in the direction of reduction. To these cavities I am applying the term *caecostomata*, as suggested by Professor Setchell, to distinguish them from the true cryptostomata with ostiole and paraphyses. In *F. furcatus* f. *typicus*, as I am limiting that species, they are very abundant, up to four hundred and fifty in each square centimeter, and there are no cryptostomata. In certain other forms of *furcatus* there are a few cryptostomata perfectly formed very early. The caecostomatal character seems quite effectually to mark off

a distinct group, the distribution of whose members extends as far north as Sitka, Alaska, with the southern limit in San Luis Obispo County, California. Along with this character is usually found a decided olive green color.

Fucus nitens refers to a group of plants growing in San Francisco Bay, which seems not to fit in well with any other described species. It doubtless is an offshoot of the *furcatus* group, and very probably hybridizes with it.

The decision in the selection of *edentatus* as against *inflatus* for the specific name seemingly best suited to certain of our narrow forms is based upon the study of the original descriptions and illustrations of the type specimens of each species.

Fucus inflatus dates back to Flora Lapponica, of Linnaeus, 1737. The diagnosis as given by Linnaeus in Species Plantarum, 1753, p. 1159, is: "Fucus fronde bifida; laciniis ovato-lanceolatis inflatis apice divisis." This will suffice in part for any species of *Fucus* that has been proposed, just as well for one as for another. Through the kindness of Dr. M. A. Howe, I have a habit sketch made by him of two small parts of plants in the Linnaean Herbarium which, according to Dr. Howe, is all that is left to indicate Linnaeus' conception of this species. These small bits are sterile and Dr. Howe remarks, "The enlargements, to which it owes its name, are possibly inflations which have been flattened down in pressing, but I find no certain evidence of this in the Linnaean specimen." Thus neither the description nor the specimens seem to me in the least adequate to give one even an approximate idea as to the concept of Linnaeus regarding this species. Vahl, in Flora Danica, plate 1127, gives a diagrammatic sketch and a brief diagnosis showing his conception of the species. The sketch is certainly of a plant quite different from that of Linnaeus. Of late years there has been as great confusion in the use of the term *inflatus* as in the use of *furcatus*. Foslie (1886, p. 109) proposes *F. inflatus* (L.) Vahl for certain narrow forms. Kjellman (1890, p. 11) adopts the name for a group of plants which he first separates into two groups, *α Finmarkicus* and *β Nordlandicus*, under which he describes nine different forms. He left no illustrations and made no attempt to show their relation to other described forms. Rosenvinge (1893, p. 834) uses the name *inflatus* to include *F. edentatus* De la Pyl., *F. evanescens* Ag., and *F. linearis* (Ed. De-Toni (1895, p. 195) accepts the group as proposed by Kjellman. Börgesen (1902, p. 465) uses the term *inflatus* to include certain Faeröe Island plants which he designates as

formae *edentatus, distichus,* and *linearis.* Setchell and Gardner (1903, pp. 280, 281) used the term *inflatus* to include certain plants in the Puget Sound region which were placed under the forms *edentatus, linearis,* and *filiformis* of this species.

The type of *F. edentatus* De la Pyl. is in the herbarium of the Museum of Paris. Dr. M. A. Howe has examined and photographed this type specimen and through his courtesy I have received a print of the negative, which I have reproduced on plate 60, figure 1. I have examined dried specimens from the north Atlantic coast of a relatively narrow form, which are smooth and black on drying and free from caecostomata, which seem to me to correspond with the description and illustration of the type of *edentatus.* Several of our forms which have been previously associated with *F. inflatus* seem, on close comparison with these eastern specimens, to belong with the *edentatus* lineage rather than with the much more vague *inflatus* lineage, and I am placing them in accordance with this view.

I am using the term *edentatus* as a *species major* to include mostly narrow, smooth, and glossy forms, almost black on drying, practically free from caecostomata and with few cryptostomata.

There are remaining certain northern forms which do not seem to fit in well with any of these groups. They have more or less membranaceous fronds, with no caecostomata, are usually decidedly yellowish in color, have the cryptostomata most abundant on the terminal and subterminal segments and these cryptostomata protrude on drying. These I have grouped under the *species major* which I have designated as *membranaceus.*

In treating of the *Fucus* flora of the northwest coast of North America, Setchell and Gardner (1903, p. 281) adopted *Fucus evanescens* as a satisfactory name to include most of the forms then known in that region. This species thus is given the widest range in distribution of all the described species, since this name has been applied to plants of both shores of the North Atlantic and of the North Pacific as well as of the Arctic oceans. One of the chief characters upon which this species is based, viz., the vanishing of the midrib in the terminal and subterminal segments, is as fluctuating as any other character. It may be seen on plate 35 that the midrib extends to the very tips of the segments. This plate represents a plant from Spitzbergen determined by J. Agardh. Three fragments of plants, no. 132622 of the Herb. Univ. Calif., from the same region collected by Kjellman likewise show the midrib quite distinctly. Plate 1, figure 2,

represents the original figure of Agardh and shows very little midrib in the terminal segments nor in other parts of the frond. My own experience with this character is that it cannot be relied upon as having very pronounced diagnostic value, except in a few cases. The type locality is said to be Kamtschatka and, according to Setchell, the type specimen is in the herbarium of J. G. Agardh, under no. 00299, with a query. Kjellman has described ten forms of *evanescens* and reduced J. Agardh's *F. bursigerus* to a form of the same species. Stroemfelt (1886, p. 35) added f. *dendroides*. De-Toni (1895, pp. 201–203) accepts all these forms as valid. Setchell and Gardner (1903, p. 283) added two more. Most of Kjellman's forms have been recognized with some degree of certainty in the northern portion of the range considered here. The plants so listed, however, seem almost invariably to be more robust than those of Kjellman's finding. On the whole, the species as understood in Europe, seems to me to be the best suited to include the most of the forms of *Fucus* growing in the North Pacific region, having more or less coriaceous fronds for the most part robust, with a brownish or yellowish color, with relatively few cryptostomata.

Diagnostic Characters

In attempting to diagnose our forms, I have made use only of the gross morphological features. I think, however, that it would be quite within the bounds of possibility that histological characters could be made use of effectually in determining limits. The shape and size of the oögonia and antheridia vary considerably, but I have not carried the study far enough to determine whether a fixed difference may be present and detectable, or whether the difference may be due simply to fluctuating variation. The only satisfactory way to prosecute such study is by the use of fresh or fixed material.

The following characters have been used in rendering the diagnosis in this work:

The *holdfast*, in all cases, is a solid, somewhat fibrous disk, larger or smaller according to the species and to the nature of the substratum and the environment, which serves to anchor the plant. The plants growing on the open coast, exposed to heavy surf, usually have the most robust holdfasts. Those plants growing on wood in quiet waters usually have smaller, poorly developed ones. Plants growing under the latter conditions usually do not persist long.

The *stipe* is a term rather loosely applied in this group. Strictly speaking, it should apply to that portion of the frond between the

holdfast and the first forking, varying in different species from one centimeter to five centimeters in length. As the plant grows older the alae wear away, more or less, and the midribs among the segments, or branches, thicken; flat at first, they become more nearly cylindrical and virtually become a part of the stipe. The length of the stipe and its degree of flatness are characters of considerable value in determining species.

The term *segments* is understood to apply to those portions of the frond between each forking. Characters of the segments which are of morphological value in determining the species are the general shapes, the most prominent of which are linear and cuneate, thickness and width of the *alae*, and the extent of the development of the *midrib*. The nature of the terminal segments is often of pronounced value.

The *growing point* is located at the base of a flattened, more or less crescent-shaped pit of considerable depth at the outer ends of the terminal segments. They are thus situated back of what appear to be the ends of the segments. The nature of these terminal depressions is of some diagnostic value.

Receptacle is a term used to designate the metamorphosed free ends of the terminal segments, for the purpose of developing the reproductive organs, oögonia and antheridia. These organs are borne along with sterile filaments, the *paraphyses*, in cavities, the *conceptacles*, scattered in various ways over the surface of the receptacles. The receptacles vary much in shape, even on the same individual, as well as on different individuals and on different species. Some are complanate and possess little mucilaginous substance, others are much swollen and filled with the same substance and still others are inflated with gases. Receptacular characters, though variable, are of considerable value in determining species.

Cryptostomata, when applied to the genus *Fucus*, is a term that has been applied to certain cavities scattered promiscuously, or arranged more or less definitely, over the whole frond except the stipe and the holdfast. They are not confined to this genus alone, however, but have been more thoroughly investigated in *Fucus* than in any of the other genera. They appear in other members of the Fucaceae, and also in several genera of the Laminariaceae. The cavities may or may not have sterile, hyaline hairs, *paraphyses*, in greater or less profusion and, when present, extruding at times through an opening at the top called the *ostiole*. These paraphyses disintegrate sooner or later, and even the whole cryptostomata may disappear entirely as the lower parts

of the front metamorphose. The phylogeny, functions, and development of the cryptostomata have been the subjects of considerable discussion and investigation among algologists. It is not my purpose here to go into an extensive discussion of the literature on these subjects. A few statements, however, may be of service in this connection.

Bower (1880, p. 36) briefly reviewed the literature that had been published on the investigations of the subject of the cryptostomata up to that date, bearing particularly upon their origin. Oltmanns (1904, 1905) has given a much more exhaustive account of opinions and investigations, including his own, on all phases of the subject. Regarding the phylogeny and functions of these organs, the investigations up to the present time seem to have been too meager to warrant any satisfactory general conclusions. That which seems to me to be the most satisfactorily assignable function of the paraphyses is one suggested to me by Dr. Setchell, first mentioned by Reinke (1875, p. 230), viz., their connection with nutrition. Reinke compares them to root hairs of the higher plants, serving to increase the absorbing surface. In whatever species they occur, they originate and are most vigorous in meristematic tissue, either in ephemeral or in perennial species. They would thus seem to be homologous to root hairs in the higher plants, exposing a greater absorbing surface at the time and in the place of greatest need for food, soon disappearing after having served their purpose.

So far as the genus *Fucus* is concerned, the investigations of Bower (*loc. cit.*) seem definitely to have settled the question of the origin and development of the conceptacles as well as the cryptostomata. He shows that they originate just back of the growing point, in the depressions at the apices of the fronds, by the failure of a single surface cell to divide horizontally, and its subsequent disintegration. From this beginning he carefully traces and figures the enlarging cavity resulting, and the differentiation of the reproductive organs and sterile hairs. I have verified the results of Bower's investigation so far as the initial step in the formation of these organs is concerned.

Having frequently noticed forms of *Fucus*, particularly from the region of Puget Sound southward to the southern limits of its distribution, in which the cryptostomata were deep-seated, completely closed, and destitute of paraphyses, I was prompted to investigate their origin with a view to determining the use to which this character might be put in placing the species. Several genera of the Fucaceae

have the conceptacles promiscuously distributed over practically the entire frond. In others, e.g., *Fucus, Pelvetia,* the reproductive structures are limited to the metamorphosed ends of the segments. The cryptostomata in the genus *Fucus* are so intimately associated with the conceptacles, both being the same in their method of origination and similar in their form, as to make it seem quite logical to conclude that they are degenerated conceptables. Indeed Bower has so considered them, speaking of them as "incomplete sexual conceptacles." Adopting this line of reasoning one may readily conceive that it is only a step further in the line of reduction evolution to produce a plant in which none of the cryptostomata develop paraphyses and all remain completely arched over, leaving no ostioles. *Fucus* on the west coast of the United States abounds in forms having structures of this nature. Such cavities I have designated *caecostomata* as distinguished from cryptostomata, and I am using them as one of the distinguishing characters of a *species major,* viz., *Fucus furcatus* (see above, p. 9). The next stage in reduction would be the complete elimination of both caecostomata and cryptostomata, and approximately this condition exists in the *species major, Fucus edentatus.*

The *color* character is of considerable value in determining species. This character, however, is subject to a certain amount of variation and cannot be solely relied upon. The color of an individual may vary with age and with exposure. In dense clusters of plants the lower portions have a more intense color than the upper part. All species are darker on drying than in the living state, and the color distinction between species may be more pronounced and constant in the dried specimens than in the living plants.

The *habitat* of a plant cannot be said normally to be a specific determinant, though a knowledge of the normal habitat of a plant, if markedly different from that of another plant, may assist in establishing to a certainty the belief in the entities of two closely related forms. *Fucus evanescens* f. *robustus* is never to be found growing outside of a narrow belt along high-tide limit. *F. membranaceus* f. *latissimus* inhabits exclusively the lower littoral limit. If there were nothing in gross morphology to distinguish these two species, this fact alone would lend plausible support to the belief that the two are distinct entities, each with a separate lineage.

Fucus furcatus Ag.

Plate 1, figure 1

"Fronde lineari enervi plana furcata, receptaculis terminalibus."
"Ad Unalaschka, Chamisso."
"Vidi in herbario Chamissoi."
"*Frons* plana, digitalis, linearis, parum dilatata, lineam vel sesquilineam lata, 2–3 furcata, omnino enervis. *Receptacula* plana, unciam vel sesquiunciam longa, fronde latiora, semper furcata, segmentis attenuatis obtusis, tuberculatis; tuberculis pertusis continentibus glomerulos gelatinoso-filamentosos, in quibus capsulae ovatae limbo hyalino circumfusae numerosae nidulantur. *Color* exsiccatae nigerrimus. Substantia cartilaginea, exsiccatae rigida."
Agardh, Sp. Alg., vol. 1, 1820, p. 97.

Fronds usually rigid, often arborescent, more or less cartilaginous, for the most part decidedly mucilaginous, regularly dichotomous, olive green to yellowish; segments usually relatively long, slightly cuneate to linear, in some cases decidedly crisped, midrib prominent and percurrent and often yellowish, caecostomata few to very many; receptacles for the most part complanate, sometimes tumid, often decidedly yellowish.

Growing in the middle and lower littoral belts. From Sitka, Alaska, to Oil Port, San Luis Obispo County, California.

Agardh, *loc. cit.*, Icon. Ined., fasc. 2, 1821, pl. 14, Syst., 1824, p. 279; J. Agardh, Sp. Alg., 1848, vol. 1, p. 209.

For a discussion of this *species major* see page 9.

Fucus furcatus f. **typicus** f. nov.

Plates 2 and 3

Frons paullo caulescens, paululum cartilaginosa, 20–30 cm. alta, regulariter dichotoma, obscure olivaceo-viridis, siccata atra, segmentis planis, linearibus vel cuneatis, 10–18 mm. latis, costa distincta, percursa, caecostomatibus 250–300 in quoquo cm. quadrato, parvis, inconspicuis, cryptostomatibus nullis vel sparsissimis; receptaculis complanatis, saepissime late linearibus, 4–6 cm. longis, saepissime bifidis, apicibus acutis; conceptaculis numerosissimis et comparative parvis.

Growing on boulders and rock ledges in the middle of the littoral belt. From the Strait of Juan de Fuca to central California.

Type, Setchell, no. 1691 (Herb. Univ. Calif., 99171), Fort Ross, California, June, 1897. Gardner, no. 2187 (Herb. Univ. Calif., no. 201151), Moss Beach, San Mateo County, California, April, 1910.

Fucus evanescens f. *typicus*, Collins, Holden and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. 1338. *Fucus inflatus* f. *edentatus*, Setchell and Gardner, Alg., N. W. Amer., 1903, p. 280.

The *Fucus furcatus* of Tilden's American Algae, no. 234, as to the specimen distributed in Professor Setchell's copy, is not typical of this species as found on the California coast. The specimen is only a small portion of a plant. It is mature, considerably worn and battered, and has comparatively few caecostomata. The distribution is probably to be referred to f. *typicus,* but it is desirable to consult other specimens of the distribution before deciding definitely.

This form is abundant on the California coast, but less common toward the north, being supplanted by numerous other forms. It reaches its optimum growth in localities where the surf is only moderately active. In such situations it attains its greatest height, not infrequently specimens attaining a height of 4.5 dm., but when on boulders exposed to a heavy surf, it remains much shorter, is more arborescent, the alae wearing away up to the last segment. The illustration on plate 3 is of the former state, and that on plate 2 is from an exposed situation at Fort Ross, California, presumably the type locality for the species. I have selected this specimen as the type because it shows the proliferating habit which seems to be the character of the specimen illustrated by Agardh (see plate 1, figure 1). There is considerable individual variation in the width of the segments. The dimensions given in the diagnosis cover a very large majority of individuals in a bed of plants, but occasionally wider or narrower plants may be found. They fruit abundantly, only an occasional segment remaining sterile to continue the growth and fruiting in the next season if the plant persists. Most of the segments fruit simultaneously, and the height of the fruiting season is in June and July; some receptacles may, however, be found at any season of the year, as is usually the case with all the species of the genus.

The specimens after desiccation readily yield a copious amount of mucilaginous substance on being revived, either with fresh or with salt water. It was hoped that the copious secretion of mucilage might be traced to the caecostomata which are so abundant in this species, and that this definite function might be assigned to them, but it has not been possible to connect these structures with this function.

Fucus furcatus f. **angustus** f. nov.

Plate 4

Frons angusta, caulescens, rigida, subcartilaginosa, 20–35 cm. alta, dichotoma, obscure olivaceo-brunnea, siccata atra; segmentis linearibus vel paululum cuneatis, 4–7 mm. latis, apicibus truncatis, costa evidenter percursa, caecostomatibus 125–175 in quoquo cm. quadrato; receptaculis vulgo complanatis, interdum inflatis, distincte definitis, alte bifidis, 4–7 cm. longis, apicibus acutis vel acuminatis; conceptaculis numerosis confertim dispositis.

Growing in abundance on rock ledges in the upper third of the littoral belt. San Juan County, Washington, and the central coast of Oregon.

Type, Gardner, no. 2788 (Herb. Univ. Calif., no. 201188), Sunset Beach, near the mouth of Coos Bay, Oregon, May, 1914.

The only other definite locality in which this form has been detected is Cattle Point, at the south end of San Juan Island, Washington (Gardner, no. 2352*g*). This locality is particularly rich in forms of *Fucus*. There is an intermingling of the waters flowing among the islands to the north and east, which have a varied *Fucus* flora, with the waters from the Strait of Juan de Fuca and the Straits of Georgia, washing the shores of land to the west and north, which have a somewhat different *Fucus* flora. The shore of the south side of Cattle Point is exposed to a swiftly flowing current and to the action of swells from the Pacific Ocean, through the Strait of Juan de Fuca. Around to the north side of the point the shores are affected but little by the action of the surf and tides.

Fucus furcatus f. *angustus* seems closely related to *F. inflatus* f. *edentatus* of Börgesen. I draw my conclusion after having compared our plants with a specimen of Börgesen's from the Faeröe Islands in the Herbarium of the University of California, no. 99176. I have represented this specimen on plate 20. Börgesen's specimen has a more pronounced midrib and the segments are more decidedly cuneate. The color is not so dark as the color of our specimen. The fronds are somewhat roughened and possess a large number of caecostomata, very similar to f. *angustus*.

Fucus furcatus f. **linearis** f. nov.

Plate 5

Frons paullo caulescens, cartilaginosa, 30–35 cm. alta, ramosissima dichotoma, obscure olivaceo-viridis, siccata atra; segmentis strictis, linearibus, 8–12 mm. latis, caecostomatibus 40–70 in quoquo cm. quadrato, siccatis inconspicuis; receptaculis numerosissimis distincte definitis, quam frondibus latioribus, integris vel bifidis, vulgo ovatis, 1.5–2 cm. longis; conceptaculis numerosis, amplis.

Growing in quiet water on boulders in the lower littoral belt. Tracyton, Kitsap County, Washington.

Type, Gardner, no. 2206*b* (Herb. Univ. Calif., no. 201142), May, 1910.

This form is remarkable for the abundance of receptacles it produces on a single plant. Plate 5 was made from a portion of a plant that had approximately five hundred and fifty receptacles. It is also rather unusual that so many of the segments should fruit at the same time as is the case in this form. Not a single segment remained sterile in the above mentioned plant. This form does not seem to be abundant in the Puget Sound region.

Fucus furcatus f. **abbreviatus** f. nov.

Plate 6

Frondes cartilaginosae rigidae, asperae, 8–12 cm. altae, regulariter dichotomae, olivaceo-virides vel olivaceo-brunneae vel luteolae; segmentis cuneatis vel linearibus, 8–16 mm. latis, apicibus truncatis, costa angusta evidente, caecostomatibus comparative amplis, siccatis prominentis, 60–80 in quoquo cm. quadrato; receptaculis distincte definitis quam segmentis multo latioribus, 2–2.5 cm. longis, complanatis vel muco inflatis, 1–2-furcatis, apicibus acuminatis; conceptaculis numerosis valde prominentibus.

Growing on boulders in the middle littoral belt. Islands of San Juan County and vicinity, Washington.

Type, Gardner no. 2347 (Herb. Univ. Calif., no. 201200), Waldron Island, San Juan County, Washington, July, 1910.

This form is fairly abundant in the moderately quiet waters among the islands of San Juan County, Washington, and extends into the upper Sound region. It varies considerably in size, both in length and in width of the fronds. Specimens 3 to 4 cm. in height have been taken in full fruit, but these were depauperate forms, in the upper

limit of the belt in which they grow. The striking features of this form are the short bunchy habit, the abundance of well developed receptacles appearing simultaneously, and the numerous large caecostomata making the fronds rough, particularly prominent on drying.

Fucus furcatus f. **cornutus** f. nov.

Plate 7

Frondes subcoriaceae, 20–30 cm. altae, regulariter dichotomae, obscure olivaceo-virides vel obscure olivaceo-brunneae siccatae atrae; segmentis divergentibus, linearibus vel iis angustioribus paullo cuneatis vel iis latioribus manifeste cuneatis, 5–6 mm. latis, apicibus acuminatis, truncatis, costa distincte exposita, prominente, superne paululum evanida, alis angustis, caecostomatibus sparsissimis, parvis, 10–20 in quoquo cm. quadrato; receptaculis distincte definitis, valde variabilibus, complanatis vel inflatis, vulgo quam segmentis multo latioribus, integris, vel bifurcatis, 2–4 cm. longis, obtusis vel acuminatus, apicibus vulgo a laterale reflexis; conceptaculis non numerosis, inconspicuis.

Growing on rocks in the middle and lower littoral belts. From Yakutat Bay, Alaska, to Victoria, British Columbia.

Type, Gardner, no. 3993*a* (Herb. Univ. Calif., no. 201193), Sitka, Alaska, July, 1917.

Fucus evanescens f. *cornutus,* Saunders, Alg. Harriman Exp., 1901, p. 432, pl. 62, fig. 2; Collins, Mar. Alg. Vancouver Isl., 1913, p. 111; Collins, Holden and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. 927.

I have not seen the Saunders' specimen, but have based my judgment upon his description and figure quoted above, which seem to agree very well with my specimen from Sitka. He states that some of the receptacles are up to 7 cm. long, being much longer than any which I have seen.

The narrow fronds with prominent midribs and the very dark color make this form close to certain narrow forms of *edentatus*, but the absence of cryptostomata and the small caecostomata relate it to the *furcatus* group. It has the least number of caecostomata of all the forms with which I am familiar, certain specimens being nearly free from them. In this character the form approaches very closely to the *edentatus* group.

Fucus furcatus f. **nigricans** f. nov.

Plate 8

Frondes comparative fragiles, tenues, membranaceae, 35–45 cm. altae, regulariter dichotomae, obscure olivaceo-viridis, siccatae atrae, angulis latis paulum rotundatisque; segmentis inferne cuneatis superne linearibus, ad segmenta terminalia 3–4 infra apicibus ad costam diminuatis, ad singulem axillam diminuatis, usque ad 18–24 mm. latis; costa angusta distincta, percursa, alis tenuibus, caecostomatibus 70–80 in quoquo cm. quadrato, parvis, obscuris; receptaculis 2.5–3.5 cm. longis, complanatis vel inflatis, integris vel bifidis, manifeste definitis, apicibus plerumque acutis reflexisque.

Growing on boulders and rock ledges in the middle of the littoral belt. Cattle Point, south end of San Juan Island, Washington.

Type Gardner, no. 2352*h* (Herb. Univ. Calif., no. 201195), July, 1910.

Plate 8 represents the type specimen of this form. Comparison of this plate with a representation of the type specimen of Kjellman's *F. evanescens* f. *cornutus* on plate 55 shows the much more pronounced cornute habit of the receptacles than Kjellman's plant possesses. In this habit, forma *nigricans* is closely akin to forma *cornutus*, but differs from it in the following characters: thinner fronds which are more cartilaginous, darker color, black on drying, in having widely divergent segments and in having an abundance of caecostomata.

Fucus furcatus f. **elongatus** f. nov.

Plate 9

Frons sparse ramosa, distincte arborescens, parum foliacea, 3–5 dm. alta, regulariter dichotoma, angulis latis rotundatisque, obscure olivaceo-viridis, siccata obscure olivaceo-brunnea, segmentis longis, 10–18 mm. latis, cuneatis, segmento terminale saepe ovato, puncto crescente parum depresso, costa angusta evidente, vulgo superne luteola, alis inferne attritis, ad 4–5 segmenta terminalia persistentibus, caecostomatibus variabilibus vulgo numerosis, usque ad 450 in quoquo cm. quadrato, cryptostomatibus paucis, sparsis, paraphysum fasces longos exsertes gerentibus; receptaculis obscure brunneis vel luteolis, aut complanatis aut multo inflatis, distincte definitis, integris emarginatis vel bifidis, obtusis vel acutis, 3–5 cm. longis; conceptaculis nec prominentibus neque numerosis.

Growing on boulders in the lower littoral belt in localities exposed to the surf. South end of San Juan Island, Washington, and Sunset Beach, near the mouth of Coos Bay, Oregon.

Type, Gardner, no. 2793 (Herb. Univ. Calif., no. 201178), Sunset Beach, Oregon, May, 1914.

This form is intermediate, in several of its characters, between *F. furcatus* f. *typicus* and *F. furcatus* f. *luxurians*. On drying it is smoother than either of the above mentioned forms, the caecostomata not standing out so prominently.

The type (plate 9) was collected in May, and, although fruiting abundantly, may possibly be immature, judging from the number of blunt receptacles. No. 2352*b*, Gardner, from San Juan Island, was collected in July and the receptacles have apparently reached their maximum size. The plants from this locality are scarcely typical in every respect. The fronds average slightly narrower and the caecostomata are much fewer, but it seems too close to be segregated under a form name. Gardner, no. 1973 (Herb. Univ. Calif., no. 132743, and in Collins, Holden, and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. CX, sub *F. evanescens* f. *macrocephalus* Kjellm.) is typical of f. *elongatus* in color, character of branching, having mostly wide and usually rounded angles, character of segments and receptacles, but varies from the type in having very few caecostomata. It is certainly quite different from Kjellman's *F. evanescens* f. *macrocephalus* in all of its important characters. Compare plate 9 with plate 46, representing Kjellman's type.

Fucus furcatus f. **luxurians** f. nov.

Plate 10

Frons distincte caulescens, cartilaginosa, alis attritis, costa densa in complanatum stipitem transeunti, regulariter dichotoma, 4–5 dm. usque ad 9 dm. alta, obscure olivaceo-viridis vel olivaceo-brunnea, costa receptaculisque luteolis, disco radicali magno firmoque; segmentis variabilibus late cuneatis vel fere linearibus, saepe ad costam oblique fissentibus, 1.5–3 cm. latis, terminale saepe latiori rotundatoque, caecostomatibus numerosissimis, 300–350 in quoquo cm. quadrato, cryptostomatibus sparsis, paraphysum fasces longe exsertes gerentibus; receptaculis manifeste definitis, 4–6 cm. longis, complanatis vel acuminatis; conceptaculis numerosissimis.

Growing on boulders and rock ledges in the middle of the littoral belt. Northern and central California.

Type, Gardner, no. 4327 (Herb. Univ. Calif., no. 201220), Moss Beach, San Mateo County, California, July, 1918.

Plate 10 represents a plant of this form in mature fruit, producing receptacles for the first time. The receptacles in this specimen are all complanate, a condition which prevails very commonly, but in certain localities the receptacles are tumid and mucilaginous.

Forma *luxurians* is closely related to forma *typicus*. The two forms often grow intermingled, but may readily be distinguished by differences in size and color, forma *luxurians* being much more robust, and of a lighter brownish or yellowish color in the upper parts, particularly the receptacles. The southern limit of the form, as of all forms of *Fucus* so far as is at present known, is Oil Port, San Luis Obispo County, California. The northern limit has not yet been determined, but it probably extends as far north as Cape Flattery, Washington, where there is an intermingling of several forms whose limits have not yet been determined. It merges into forma *elongatus* from Coos Bay, Oregon, which I have segregated, as is illustrated on plate 9.

The plants persist for several years, are in fullest fruit in early summer, although some receptacles may be found at any season of the year. Always a portion of the segments resulting from forking remains sterile. These continue to grow and branch, forming segments for the next year's receptacles, while the other segments fruit and disintegrate, leaving the midrib of the segment as a pointed projection. The plants do not seem to proliferate. Many of the alae split obliquely to the midrib, giving them a serrate appearance. Plants growing at Pacific Grove, California, which I have referred to this form, are subject to this habit quite generally. I have noticed also that in this locality the plants have a decided tendency, toward the end of the growing season of the receptacles, to establish several meristematic regions on the ends of the receptacles, some of which produce quite prominent and pointed projections with a tendency to becoming vegetative, as many as ten having been observed on a single receptacle with a common wide base.

Fucus furcatus f. **reflexus** f. nov.

Plates 11, 11*a*, and 12

Frondes foliaceae, subcartilaginosae, 30–45 cm. altae, regulariter dichotomae, obscure olivaceo-virides vel obscure olivaceo-castaneae, angulis saepissime latissimis rotundatisque; segmentis inferne cuneatis, terminalia saepe obovatis, 8–25 mm. latis, apicibus rotundatis, puncto crescente paululum depresso, costa angusta distincta, superne paullo evanida, caecostomatibus numero variabilibus, 50–150 in quoquo cm. quadrato; receptaculis manifeste definitis, substipitatis, complanatis, ellipsoideis, integris vel bifidis, late patentibus; conceptaculis parvis numerosisque.

Growing on boulders in the lower littoral belt. Point Defiance, Tacoma, Washington.

Type, Gardner, no. 2190 (Herb. Univ. Calif., no. 201145), May, 1910.

The consistency of this form is somewhat like that of the *evanescens* group, the tissues being more delicate and soft than those of the typical *furcatus* forms. I have placed it in the *furcatus* group on account of the color, dark olive green to dark olive brown, and the presence of cryptostomata in abundance.

Many of the terminal segments are very broadly ovate, almost stipitate, on account of the narrowing of their bases, producing broad rounded angles between the segments (plate 12). The growing points differ from those of all other forms observed on our coast, the apices of the segments being rounded and smooth, but with slight inconspicuous slits to indicate the position of the growing point.

The receptacles, particularly when young, have the pronounced and distinguishing character of spreading very widely from each other at their bases, in some instances standing at right angles, or even more, to each other. Many segments have the character of reducing their width at each forking, the terminal segments forming the stipelike portion bearing the much wider receptacles.

Fucus furcatus f. **rigidus** f. nov.

Plate 13

Frondes robustae, rigidae, cartilaginosae, 30–45 cm. altae, dichotomae vel subsecundae, obscure olivaceo- virides, siccatae atrae, costa et receptaculis subtus olivaceo-viridibus, supra olivaceo-brunneae vel luteolis, angulis saepissime rotundatis; segmentis linearibus vel paullo cuneatis, strictis, 1.5–3 cm. latis, apicibus truncatis, costa prominente, caecostomatibus 60–100 in quoquo cm. quadrato; receptaculis indistincte definitis, complanatis, linearibus, apicibus acuminatis, 2–3-furcatis, 12–20 mm. latis, 5–8 cm. longis; conceptaculis magnis partem cuneatem e receptaculo costam decurrentem vestientibus.

Growing on boulders in the lower littoral belt. Port Townsend and west coast of Whidbey Island, Washington.

Type, Gardner, no. 1982 (Herb. Univ. Calif., no. 201138), Port Townsend, Washington, July, 1908. Gardner, no. 2352*a* (Herb. Univ. Calif., no. 201214), from San Juan Island, seems also to belong here. Most of the specimens of this latter collection have shorter receptacles with wider base and with most attenuate and divergent apices.

According to my conception of this form, its phylogenetic position is between forma *latifrons* and forma *luxurians*. From the former it differs in having a more rigid cartilaginous structure, in having narrower and more strict segments, and in having longer and narrower receptacles. From the latter it differs in having more strict and more nearly linear segments and longer and narrower receptacles.

Fucus furcatus f. **latifrons** f. nov.

Plate 14

Frons distincte foliacea, contorta, comparative tenuis, 25–35 cm. longa, inferne obscure olivaceo-brunnea, superne pallide brunnea, siccata atra, dichotoma, angulis vulgo acutis; segmentis cuneatis, segmentis terminalibus vulgo rotundatis, 2–3.5 cm. latis, costa inferne prominente, superne distincte diminuante, caecostomatibus 40–80 in quoquo cm. quadrato; receptaculis indistincte definitis, complanatis, 2–3-furcatis, vulgo acutis; conceptaculis amplis, vulgo costam descendentibus, segmenti partem cuneatam vestientibus.

Growing on rocks in the middle and lower littoral belts. Channel Rocks, near Fort Ward, west of Seattle, Washington.

Type, Gardner, no. 1972 (Herb. Univ. Calif., no. 201221), August. 1908. *Fucus evanescens* f. *pergrandis*, Collins, Holden, and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. XCI.

In width of fronds, this form of *F. furcatus* overlaps or merges into forms of *F. evanescens*, e.g., forma *magnificus*. I am placing it under *furcatus* on account of the dark olive green color, more or less cartilaginous consistency, and particularly on account of the abundance of caecostomata.

It is closely related to *F. furcatus* f. *rigidus*, but the fronds are more foliaceous, the receptacles are wider and shorter and the caecostomata are less abundant.

Fucus furcatus f. **contortus** f. nov.

Plate 15

Frons 20–30 cm. alta, inferne caulescens, superne foliacea, robusta, cartilaginosa, valde contorta, dichotoma vel subdichotoma, inferne olivaceo-viridis, superne luteola, siccata obscure olivaceo-castanea; segmentis inferne cuneatis marginibus crispatis, superne linearibus, supra axillas diminuatis, 2–2.5 cm. latis, apicibus rotundatis, depressione crescente parva, costa prominente, caecostomatibus 250–300 in quoquo cm. quadrato, siccatis minute papillosis; receptaculis complanatis, 4–7 cm. longis, indistincte definitis.

Growing in quiet water on boulders in the lower littoral belt. Near Bellingham, Washington.

Type, Gardner, no. 2335 (Herb. Univ. Calif., no. 201189), July, 1910.

A dried fragment of a plant of this form is shown on plate 15. The form seems to be quite distinct from all others. Its color, its rigid, cartilaginous consistency, its relatively wide fronds, its large

number of caecostomata, its contorted and crisped habit of growth are characters not found combined in any other known form. The plants were found growing in great profusion, in good vegetative condition in midsummer. The fruiting season apparently is in the winter, as only a few well developed receptacles could be found.

Fucus furcatus f. **variabilis** f. nov.

Plates 16 and 17

Frons caulescens, superne foliacea, 25–40 cm. alta, subcartilaginosa, dichotoma vel partim subsecunda, obscure olivaceo-viridis vel olivaceo-brunnea, siccata atra, costa et receptaculis luteolis; segmentis linearibus vel paullo cuneatis, 2–3.5 cm. latis, plerumque supra axillas in latere diminuatis, costa vale exposita, percursa, caecostomatibus in numero variabilibus, paucis usque ad 75 in quoquo cm. quadrato; receptaculis forma et magnitudine variabilibus, manifeste definitis, inflatus et mucosis vel complanatis, integris obtusisque vel 2–3-furcatis acuminatisque.

Growing on rock ledges in quiet bays in the middle of the littoral belt. Sitka, Alaska.

Type, Gardner, no. 3993 (Herb. Univ. Calif., no. 201219), July, 1917.

A close relationship seems to exist between this form of *F. furcatus* and *F. evanescens* f. *magnificus*. The color, caecostomata characters, and the rigid, more or less cartilaginous consistency of the fronds are characters that belong to the *furcatus* group. The width of segments and particularly the fruiting habit (see under *F. evanescens* forma *magnificus*) are very similar to those of that form. The caecostomata vary much in number. In some specimens they are practically absent, while in others there may be seventy-five or perhaps more to the square centimeter. They are mostly large, deep-seated and inconspicuous on drying, except by transmitted light. Specimens with but a few caecostomata usually have a few small cryptostomata.

Fucus nitens sp. nov.

Plates 18 and 19

Frondes paululum flaccidae, coriaceae, 30–40 cm. altae, regulariter dichotomae, obscure brunneae vel luteolae, in sicco valde brunneae; segmentis strictis, 9–18 mm. latis, levibus nitidisque, cuneatis, terminalibus latioribus, paullo ovatis, truncatis, puncto crescente parum depresso, costa paullo prominente, cryptostomatibus nullis vel sparsissimis; receptaculis luteolis, juvenibus complanatis, saepe demum tumidis, 2–3-furcatis, interdum usque ad 10 cm. longis; conceptaculis magnis.

Growing on boulders and rock ledges. San Francisco Bay, California.

Type, Gardner, no. 2165 (Herb. Univ. Calif., no. 201150), Sausalito, California.

This relatively small group of *Fucus* plants, although very much circumscribed in its distribution, seems so distinctly marked off in its combination of characters from other species, particularly from those in the southern portion of the range covered in this paper, that it is worthy of specific rank. The combination of characters that distinguish this species consists of the following: relatively long and narrow, smooth and glossy fronds, strict, even overlapping habit of the terminal and subterminal segments, the dark brown color with yellowish receptacles at maturity, absence of caecostomata, and the cryptostomata, when present, are inconspicuous. Its affinities with *F. edentatus* may possibly be traced, but they seem too remote to merit much serious consideration. The somewhat coriaceous consistency of the fronds suggests relationship in that particular with certain forms of *evanescens,* but on the whole it inclines more, in its consistency, to the cartilaginous consistency of *F. furcatus,* under which I have considered placing it. I have observed this species with considerable care throughout all seasons of the year for the last twenty years. In its typical habitat it seems thoroughly fixed as a distinct entity.

The chief association of plants extends along the rocky shore from the harbor at Sausalito to Point Cavallo, a distance of about two miles. There are a few smaller groups at other points in the Bay, but in all of these localities the waters are more quiet than along the shores of the Golden Gate out to the Pacific Ocean. In the localities where they are found they are never intermixed with any forms of *F. furcatus,* the only other known species on the California coast. No plants of *F. nitens* have ever been found growing on either side of the Golden Gate for some distance inside of the entrance. From Point Cavallo to some distance west of Lime Point, an interesting association exists for which I have no way of accounting, except by hybridization between these two species. A variety of intermediates exist. There are yellowish brown plants with inflated, yellowish, bi-, tri-furcate receptacles like those in the quiet waters of the Bay, but filled with hundreds of small caecostomata characteristic of *F. furcatus;* and there are plants with flat receptacles and olive green, cartilaginous fronds but which are smooth and glossy and wholly lacking in caecostomata, characters belonging to *F. nitens.* These and other combina-

tions of modifications lead me to believe that these two species must hybridize in this locality.

Both species are synoicous and hence it would be very difficult to carry out definite hybridizing experiments.

Fucus edentatus De la Pyl.

Plate 60, figure 1

"F. fronde longa valida, lineari dichotoma, integerrima, nervo percurrente plerumque vix tumido vel obsoleto; conceptaculis terminalibus, planis, simplicibus; lineari-lanceolatis; parum acutis, vulgo geminatis aut basi connatis, fronde non latioribus."

De la Pylaie, Flor. Terre-Neuve, 1829, p. 84.

Fronds usually narrow, more or less flaccid, regularly dichotomous, olive green to olive brown or yellowish, usually very black on drying; segments mostly decidedly linear, at times cuneate, midrib distinct, percurrent, cryptostomata few or none, receptacles mostly narrow, linear-lanceolate, acuminate, inflated or complanate.

Growing in the middle and upper littoral belts. From Sitka, Alaska, to Coos Bay, Oregon.

For a discussion of this *species major* see page 10.

Fucus edentatus f. **hesperius** f. nov.

Plate 21

Frondes arborescentes, 30–40 cm. altae, angustae, coriaceae, dichotomae, obscure olivaceo-virides, in sicco atrae, stipite cylindrato; segmentis strictis, linearibus, 5–10 mm. latis, apicibus truncatis et valde expositis, prominentibus, costis percursis; cryptostomatibus nullis vel summe infrequentibus, receptaculis plerumque complanatis vel partim valde inflatis, 2–3-furcatis, linearibus, 3–4.5 cm. longis apicibus acutis; conceptaculis numerosis.

Growing on rock ledges exposed to the action of the surf, in the upper third of the littoral belt. Cape Arago, at the entrance to Coos Bay, Oregon.

Type, Gardner, no. 2653 (Herb. Univ. Calif., no. 201159), May, 1914.

This form grew in abundance in company with *F. furcatus* f. *angustus*. The two groups of plants were, however, in slightly different altitudes in the belt, and were not indiscriminately intermixed. When the two sets of plants are dried, they are easily distinguishable by the smoothness of the segments, forma *hesperius* being smooth and usually shining, while forma *angustus* is rough, due to caecostomata, and is of a duller color.

Forma *hesperius* seems closely related to or is at least very similar to a narrow, smooth, dark colored form that grows on the Atlantic coast of the United States, which has been referred to different species by different authors. There is a good specimen of it contributed by Howe, under no. 150, to the Herbarium of the University of California, no. 77184, labelled *F. edentatus*. The specimen in Professor Setchell's copy of Farlow, Anderson, and Eaton's Algae Exsiccatae Americae Borealis, no. 108, is almost identical with Howe's specimen, but is referred to *F. furcatus*. I have examined no. 119 of Hauck and Richter's Phykotheka Universalis, labeled *Fucus edentatus* De la Pyl. and contributed by Collins, from Marblehead, Massachusetts. This specimen seems to be identical with the two above mentioned. It is my opinion that all three collections should be referred to *F. edentatus* De la Pyl., and, judging from the figure and description of the type as quoted above, very clearly represent the typical form of the species. None of the Atlantic specimens referred to above have caecostomata.

Fucus edentatus f. **divergens** f. nov.

Plate 22

Frondes coriaceae, leves nitidaeque, 28–38 cm. altae, regulariter dichotomae, obscure olivaceo-virides, siccatae atrae; segmentis divergentibus 7–11 mm., usque ad 15 mm. latis, inferne cuneatis, superne linearibus, supra axillas paullo diminuatis, terminalibus truncatis, puncto crescente inconspicuo, costa manifeste distincta, percursa, cryptostomatibus et caecostomatibus nullis vel sparsissimis; receptaculis 3–6 cm. usque ad 12 cm. longis, manifeste definitis, quam segmentis multo latioribus, integris vel 1–2-furcatis, vulgo late divergentibus, apicibus acuminatis vel acutis; conceptaculis numerosis prominentibusque.

Growing on rock ledges in the lower littoral belt. Kanaka Bay, San Juan Island, Washington.

Type, Gardner, no. 2338 (Herb. Univ. Calif., no. 201173), July, 1910.

This form of *edentatus* is closely related to forma *hesperius*. The fronds average somewhat wider, more robust, the angles between the segments are very much wider and more rounded, and the receptacles mostly deeply bifurcate or single, widely diverging. The average width of the segments is about 10 mm., but a few specimens were found with extremely narrow segments, about 3 mm. These were profusely branched, with wide angles, and small diverging receptacles. Also a few specimens were found with the characters of the form, but were 15 mm. wide. These few specimens I have considered as the extremes in individual variation in this particular character.

Fucus edentatus f. **costatus** f. nov.

Plates 23 and 24

Frons tenuis, subcoriacea, 15–25 cm. alta, regulariter dichotoma, luteola; segmentis manifeste linearibus, comparative longis, supra axillas in latere diminuatis, usque ad 5–8 mm. latis, terminalibus 2–4 mm. latis, costa valde exposita, percursa, alis angustis et membranaceis, cryptostomatibus sparsis, prominentibus; receptaculis manifeste definitis, integris vel vulgo bifidis, 20–35 cm. longis, apicibus acutis; conceptaculis paullo numerosis conspicuisque.

Growing on rocks in the lower third of the littoral belt. Lower Puget Sound region, Washington.

Type, Gardner, no. 2333 (Herb. Univ. Calif., no. 201199), East Sound, Orcas Island, Washington, July, 1910.

Fucus evanescens f. *angustus*, Gardner, no. 694, and in Collins, Holden, and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. 926 (cf. Setchell and Gardner, Alg. N.W. Amer., 1903, p. 284). This form does not seem to be very generally distributed in the Puget Sound region, having been observed in only a few localities.

The plants distributed in the Phycotheca Boreali-Americana as no. 926 were from the type locality, but were taken from the upper limit of the belt of distribution when the tide was well in. They are considerably battered and worn away, and thus cannot be said to be in typical condition. Plate 23 represents a young plant, the type, mostly in typical vegetative condition. Plate 24 represents two plants, showing the extremes in variation in the width of the fronds. Specimens as narrow as the narrower sterile one on the plate are rare, and at some future time may have to be considered as distinct. The illustrations were all made from dried material.

This form resembles closely *F. evanescens* f. *angustus* Kjellm. in width of fronds, and was so referred as is cited above. Subsequent to the above publications, material of that species, collected and determined by Kjellman on the Vega expedition, has been received at the Herbarium of the University of California (no. 132699). The lack of a prominent percurrent midrib, almost complete absence of cryptostomata, and especially the very small receptacles of Kjellman's material, point out unmistakably that our plant is of a different lineage.

Fucus edentatus f. **acutus** f. nov.

Plate 25

Frondes 9–15 cm. altae, disco comparative lato planoque oriundae, dichotomae, angulis acutis, olivaceo-virides, siccatae atrae; segmentis linearibus, 3–4 mm. latis, apicibus truncatis, costa valde prominente, percurrente, alis comparative angustis, persistentibus, cryptostomatibus sparsis; receptaculis singulis aut valde bifurcatis, ad finibus quibusque attenuatis, 2–2.5 cm. longis.

Growing on sandstone in the middle littoral belt. Bellingham (Fairhaven), Washington.

Type, Gardner, no. 189 (Herb. Univ. Calif., no. 201137).

Fucus inflatus f. linearis Setchell and Gardner, Alg. N. W. Amer., 1903, p. 280.

The very dark color on drying, the absence of caecostomata, and the sparseness of cryptostomata in this form seem amply sufficient to ally it with the *edentatus* group rather than with the seemingly more imperfectly defined group *inflatus*. The linear arrangement of the cryptostomata in two rows along the prominent midrib and the relatively small, pointed receptacles distinguish it from all other forms of *edentatus*.

Fucus edentatus f. **divaricatus** f. nov.

Plate 26

Frondes fragiles, plerumque 12–22 cm., rariore usque ad 32 cm. altae, regulariter dichotomae, angulis latis, stipite et ramis infernis fere teretis, saturate olivaceo-brunneae, receptaculis plerumque lutescentibus, segmentis anguste linearibus, latitudine ad furcas quasque parvis diminuatis, terminalibus acutis, 2–5 mm. latis, costa usque ad apices valde evoluta, alis fere deuntibus, cryptostomatibus paucis et inaequaliter distributis; receptaculis definite delimitatis, subulatis aut leviter complanatis, 2.5–4.5 cm. longis, plerumque simplicibus aut valde furcatis; conceptaculis conspicuis.

Growing on ledges of sandstone in the lower littoral belt. Bellingham, Washington, Comox and Ucluelet, Vancouver Island, British Columbia.

Type, Gardner, no. 2336*a* (Herb. Univ. Calif., no. 201198), Bellingham, Washington, July, 1910.

Fucus inflatus f. *filiformis*, Setchell and Gardner, Alg. N. W. Amer., 1903, p. 281; Collins, Mar. Alg. Vancouver Isl., 1913, p. 111.

Since collecting this form at "Fairhaven," a town later incorporated with Bellingham, Washington, I have had an opportunity to

study much more extensively in the same general locality. As reported in Setchell and Gardner (*loc. cit.*), it was found growing on sand rocks. It is quite common on the sand rock ledges of that vicinity, but I have learned that its normal habitat is farther down in the littoral belt than was first reported. There were but a few plants growing in the first locality mentioned, on a ledge in the upper littoral belt, but in a shaded location. The majority of the specimens were very much dwarfed. The average height in their normal habitat is about 16 cm., although some specimens were found up to 32 cm. high. Gardner, no. 2336*a*, plate 26, represents a fruiting plant of medium height from this collection.

Fucus membranaceus sp. nov.

Frondes magnitudine variabiles parvae vel usque ad 4 dm. altae, manifeste membranaceae, obscure olivaceo-brunneae vel superne luteolae; segmentis linearibus vel paullo cuneatis, strictis, alis membranaceis, costa comparative parva distincta et percursa, cryptostomatibus sparsis, plerumque ad segmenta terminalia et subterminalia dispositis, comparative parvis in sicco papillosis, receptaculis vulgo complanatis, partim inflatis, bifidis acuminatisque.

Growing in the littoral belt. From the Bering Sea to Puget Sound, Washington.

For a discussion of this *species major* see page 11.

Fucus membranaceus f. **abbreviatus** f. nov.

Plate 27

Frondes breves, membranaceae, flabelliformes, decomposite dichotomo ramosissimae, 8–14 cm. altae; segmentis strictis, anguste cuneatis vel sublinearibus, 5–9 mm. latis, apice truncatis, costa parum prominente paululum evanescente, alis tenuibus cryptostomatibus in segmentis terminalibus 20–40 in quoque cm. quadrato, ad partem frondis inferiorem paucis, parvis siccatis evidentioribus; receptaculis bifidis, plerumque muco inflatis, apice acuminatis aut truncatis, paullo divaricatis distincte definitis; conceptaculis numerosis, prominentibus.

Growing on rock ledges exposed to heavy surf, in the upper limit of the littoral belt. Sitka, Alaska.

Type, Gardner, no. 3995*b* (Herb. Univ. Calif., no. 201192), July, 1917.

Forma *abbreviatus* grew on the same islet on which forma *acuminatus* was found growing, but mostly higher up, some specimens were even above mean high-tide level. It differs from forma *acuminatus*

principally in having shorter fronds, relatively much broader and shorter receptacles, fewer cryptostomata, and it is less mucilaginous. It seems closely akin to J. Agardh's *Fucus bursigerus* from Spitzbergen, but it is more robust, and much more profusely branched than his description and figure call for (cf. J. Agardh, Spets. Alg. Till., 1868, pp. 41, 42, pl. 3). I have seen the specimen of Kjellman's *F. evanescens* f. *bursigera*, also collected at Spitzbergen. The plants of Agardh and of Kjellman are undoubtedly of the same lineage, and they are probably allied more closely to the *evanescens* lineage than to any other. The Sitka plants under consideration, on the whole, and particularly on account of size and consistency, seem closer to the *membranaceus* group than to the *evanescens* group. The two groups certainly overlap through these two forms.

Fucus membranaceus f. **acuminatus** f. nov.

Plate 28

Frons caulescens, 12–20 cm. alta, decomposite dichotoma, ramossima, brunnea aut fulva; segmentis paullo cuneatis interdum linearibus, 4–9 mm. latis, truncatis, costa in partem inferiorem distincta, infra receptaculis diminuatis, alis tenuibus membranaceis, cryptostomatibus paucis vel 50–60 in quoquo cm. quadrato, saepissime infra receptaculis ad segmenta, ad partes vetustas deficientibus, minimis, siccatis evidentioribus; receptaculis numerosis, regulariter et profunde furcatis vel interdum unicis, saepissime complanatis, angustis, acutis, 2–3 cm. longis; conceptaculis numerosis.

Growing on rock ledges exposed to heavy surf, in the upper littoral belt. Sitka, Alaska.

Type, Gardner, no. 3995 (Herb. Univ. Calif., no. 201177), July, 1917.

This form was encountered but once. It was growing in abundance on a small rocky island in front of the Sitka harbor. It grew well up in the littoral belt, exposed to the heavy action of the surf. The plants growing in the most exposed places are quite arborescent in character, the alae wearing away up to the last two or three segments, leaving the much thickened midrib. In depressions and less exposed situations, the alae were usually wider and remained on the fronds longer. The plants in this group become exceedingly mucilaginous on being soaked out after a thorough drying.

Fucus membranaceus f. **obtusus** f. nov.

Plate 29

Frons gracilis, plus minus caulescens, membranacea, 30–40 cm. alta, dichotoma, olivaceo-viridis vel castanea, siccata obscure brunnea; segmentis strictis, linearibus val parum cuneatis, comparative longis, 10–16 mm. latis, costa percursa, alis tenuibus, cryptostomatibus et caecostomatibus numero paene aequalibus, 30–40 in quoquo cm. quadrato, parvis, siccatis papillosis; receptaculis definitis, multo inflatis, plerumque singularibus, partim bifidis, 2.5–4 cm. longis, 1–1.5 cm. latis, truncatis, luteolis; conceptaculis plus minus numerosis, comparative parvis, non protrudentibus.

Growing on rocks in the middle and lower littoral belts. Sitka, Alaska.

Type, Gardner, no. 2221 (Herb. Univ. Calif., no. 201155), June, 1910.

This form has characters linking together forma *acuminatus* and forma *typicus* of this species. It has the arborescent habit common to both forms, the width of the fronds is intermediate, and the receptacles are mostly simple and blunt, like neither form.

Fucus membranaceus f. **typicus** f. nov.

Plates 30 and 31

Frons caulescens, 28–40 cm. alta, flaccida, membranacea, dichotoma, alis inferne attritis, costam comparative parvam, crassam cylindratam relinquentibus luteolis; segmentis anguste cuneatis vel linearibus, 10–18 mm. latis, puncto crescente in depressione parva lunata disposito, costa parum exposita, alis tenuibus, cryptostomatibus parvis, 20–25 in quoquo cm. quadrato, siccatis evidentibus, plerumque ad segmenta terminalia et subterminalia dispositis, receptaculis comparative amplis, distincte definitis, plerumque inflatis, bifidis, apicibus longe acuminatis; conceptaculis parum numerosis, comparative parvis, ob colorem castaneum conspicuis.

Growing on rock ledges and boulders in the middle of the littoral belt. Sitka, Alaska.

Type, Gardner, no. 3996 (Herb. Univ. Calif., no. 201213), July, 1917.

I have taken this form to be the typical form of the *species major*, more or less arbitrarily, it is true, but largely because it is a medium among the known members of the group. I know of no way that one could tell that it has given rise to all or to any of the other forms, or that any one of the other forms has given rise to it, in fact whence any of the forms came. The form was sparsely interspersed in groups among the multiplicity of forms growing in the vicinity of Sitka. It

may be readily recognized by its light yellowish color, its mostly inflated receptacles, and by its moderately narrow, long, membranaceous fronds.

Fucus membranaceus f. **limitatus** f. **nov**

Plate 32

Frondes manifeste membranaceae, 22–32 cm. altae, dichotomae, pallide luteolae, siccatae obscure brunneae, stipite et disco radicali fragilibus; segmentis strictis, vulgo cuneatis, plerumque ad axillas latioribus, 12–20 mm. latis, lobis terminalibus rotundatis, puncto crescente paullo depresso, costa non prominente, alis tenuibus, cryptostomatibus sparsissimis et non conspicuis; receptaculis vulgo inflatis, bifidis, apicibus acuminatis vulgo divergentibus magnitudine valde variabilibus, usque ad 5 cm. longis, 2 cm. latis; conceptaculis sparsis non prominentibus.

Growing on rocks, logs, etc., in sheltered localities in the upper third of the littoral belt. Point Defiance, Tacoma, Washington.

Type, Gardner, no. 2189 (Herb. Univ. Calif., no. 201160), May, 1910.

It is not easy to delineate the distinctive characters of this form associating it with the *membranaceus* group, rather than with the *evanescens* group. In many specimens the midrib is quite indistinct. The cryptostomata characters are quite as much of the one group as of the other. I am placing it provisionally with the former group largely on account of the predominance of inflated receptacles, on the membranaceous character of the fronds, and on the color.

Two forms of *Fucus* were found growing at Point Defiance, representing an interesting case in distribution. Forma *limitatus* occupied for the most part the extreme upper portion of the littoral belt, and grew on logs and boulders. *F. furcatus* f. *reflexus* grew on boulders and occupied the lower third, with an occasional plant of either form invading the central part.

Fucus membranaceus f. **latissimus** f. nov.

Plates 33 and 34

Frondes foliaceae, membranaceae, crispatae, dichotomae, 22–35 cm. altae, inferne obscure olivo-virides, superne fulvae disco radicali parvo, stipite complanato; segmentis superne paululum ovatis, inferne angustioribus cuneatisque, subterminalibus 4–6 cm. latis, costa comparative angusta percursa, alis tenuibus, membranaceis, saepe inflatis, marginibus undulatis apicibus rotundatis et levibus, puncto crescente inconspicuo, cryptostomatibus 15–20 in quoquo cm. quadrato, paraphyses multas protrusas producentibus, siccatis prominentibus; receptaculis sparsis, complanatis, indistincte definitis, basi latioribus, bi-tri-furcatis.

Growing on boulders in the extreme lower littoral belt. Kadiak Island and Sitka, Alaska.

In June, 1910, I first observed this form growing in the harbor at Sitka, but at that time I was unable to obtain good fruiting specimens. On my second visit to the same place in July, 1917, I located a large bed containing thousands of plants growing along the extreme low-tide level, and I was able to procure a number of good fruiting specimens, although the summer season does not seem to be its best fruiting season. This form may be readily distinguished from all others by its width, being the widest form in the vicinity, its membranaceous alae, its very dark lower portion, and usually yellowish upper portion, and by its much crisped habit of growth. Some of the plants of this species collected by G. B. Rigg at Kadiak Island are the widest specimens of *Fucus* that have been reported, some of the fronds measuring over seven centimeters in width.

Fucus evanescens Ag.

Plate 1, figure 2

"Fronde supra medium costata lineari integerrima subdichotoma evesiculosa, receptaculis compressis."

"Ad Sachalien, Tilesius; ad Kamtschatka, Chamisso; unde specimina communicaverunt."

"Simillimus F. vesiculosa, sed diversus. *Frons* magis flabelliformis. Segmenta cuneiformia, brevia, poris tenuissimis sparsis pertusa. Costa subobsoleta & supra frondem parum elevata, ante apicem omnino evanida, ita ut frons superne sit enervis. *Receptacula* brevia, saepe bifida, compressa nec inflata; tuberculata, tuberculis sparsis fere ut in Fuco serrato, glomerulis in gelatina filamentosa immersis."

Agardh, Sp. Alg., vol. 1, part 1, 1820, pp. 92, 93.

Fronds moderately robust sometimes arborescent, usually decidedly coriaceous, dichotomous or in part subsecund, olive brown, to yellowish above; segments often quite foliaceous and crisped, in some, narrow, cuneate to linear, midrib more or less distinct, in some cases vanishing more or less in the terminal segments, cryptostomata few to many, scattered; receptacles very variable in shape and size, long and narrow to short and blunt, bi- tri-furcate.

Growing in the littoral and upper sublittoral belts. From Bering Sea to Coos Bay, Oregon.

In Icones Algarum Ineditae, 1821, XIII, Agardh repeats the first paragraph of the above quotation in explanation of table XIII, which illustrates this species, and adds, "Specimen delineatum, ad Kamtschatka lectum, dedit clarissimus *Chamisso*. Fig. 1. Planta magnitudine naturali." I have here reproduced this figure on plate 1,

figure 2, reduced 0.3. As may be seen, the illustration measures about ten and a half centimeters long and the segments fourteen millimeters wide. There is no holdfast portion, and the illustration appears to be of only a part of a plant, hence the height of the whole plant cannot be determined. The receptacles are complanate and are comparatively short, conditions which are commonly met with in most forms of *Fucus* when beginning to fruit. The receptacles of the plant from which the illustration was made were thus probably immature. For a detailed discussion of this *species major* see page 11.

Fucus evanescens f. **nanus** Kjellm.

"F. evanescentis forma thallo circa 5 ctmr alto, 2–3 mm lato, subcoriaceo, irregulariter dichotomo, segmentis linearibus vel sublinearibus, vulgo elongatis, costa in partibus thalli superioribus saepius obsoleta, receptaculis (in speciminibus nostris parum evolutis) vel ovatis vel obovatis, dichotomis, interdum deorsum vix definitis. Exsiccatione non nigrescit."

"Green Harbour ad scopulos prope rivuli ostium jacentes in superiore aquae limite, ut sub refluxu maris denudaretur. Formas hanc sum forma typica connectentes in Mosselbay inveni."

Kjellman, Om Spetsb. Thall., II, 1877*a*, p. 4.

Fronds minute, 4–5 cm. high, 2–5 cm. wide, without distinct stipe and usually without holdfast, branching very irregularly, considerably twisted, color variable, yellowish brown to olive green, fruiting sparsely; segments extremely variable in shape and size, midrib slightly developed below, usually vanishing above, cryptostomata few or absent; receptacles entire or bifid, ovate-ellipsoidal or with divergent, blunt, or acuminate apices.

Plate 37

Growing mostly on mud flats at extreme high-tide limit, or even considerably above, among various salt marsh plants, covered more or less by fresh water. Yakutat Bay, Alaska, to Puget Sound, Washington.

Rev. Albin Johnson, no. 5712 (Herb. Univ. Calif., no. 99121), Yakutat Bay, Alaska; Gardner, no. 2256 (Herb. Univ. Calif., no. 201154), Sitka, Alaska; T. C. Frye (Herb. Univ. Calif., no. 132931), Tokeland, Washington.

Kjellman (*loc. cit.*); De-Toni, Syll. Alg., 1895, p. 203; Setchell and Gardner, Alg. N.W. Amer., 1903, p. 285.

After considerable observation in several different localities, I have come to the conclusion that f. *nanus* cannot be considered as a distinct form of any one species, but is in reality composed of a mixture of dwarfed plants of whatever species or forms of species that happen to

inhabit the region. These dwarfs are always found on mud flats, salt marshes, and quite commonly at the mouths of rivers and smaller streams where such mud flats and marshes may occur. At extreme high tides, frequently, a great abundance of plants, of whatever species of *Fucus* happens to be growing in the vicinity, are thrown up and lodge among other plants that grow there. The spores are shed and, being in a moist place, they germinate and persist for a longer or shorter time. The plants are always much gnarled and distorted, and rarely come to fruit. At the mouth of the Indian River at Sitka, Alaska, is a favorable place for the study of such dwarfed plants. There are many different forms of *Fucus* growing in the vicinity, and a great many plants are constantly being cast up on the gradually sloping flat at the mouth of the stream. There are enormous numbers of dwarfed plants in all possible stages of development and distortion. One can come to no other conclusion than that these are dwarfed plants, that they are the offspring of whatever plants may by chance be thrown up there, and that their identity can not be traced, growing as they do in such unusually abnormal environmental conditions.

Among these abnormal environmental conditions may be mentioned, first, inconstancy in the food supply due to frequent changes in the salinity of the water, resulting in great differences in the osmotic tension; second, great variation in the temperature—the fresh water from the river flows over them more or less, and its temperature is near the freezing point a large part of the year; third, variation in light intensity; and fourth, exposure to muddy water. Under such conditions it is rather a biological wonder that any forms of the genus persist at all, yet many small specimens produce seemingly viable spores.

All of our forms on the Pacific coast are synoicous. This makes the matter of tracing the ancestry of dwarfs slightly more difficult than if dioicous forms were present, without resorting to the experimental method by cultures.

The study of these dwarfed forms of brown seaweeds has been pursued quite extensively by Baker (1912) and by Baker and Bohling (1916). They traced the ancestry of certain forms and produced dwarfs experimentally. Some of these forms they claim to be fixed entities. They did not, however, try the experiment of producing sporelings from the dwarfed forms and transplanting them to a normal habitat to ascertain if they reverted at once to the original form.

Fucus evanescens f. **cuneatus** f. nov.

Plate 38

Frondes parvae, 5–10 cm. altae, membranaceae, regulariter dichotomae, olivaceo-brunneae, segmentis inferioribus distincte cuneatis, segmentis terminalibus fere linearibus, 4–8 mm. latis, apicibus truncatis, costa inconspicua, superne paululum evanida, cryptostomatibus paucis, inconspicuis; receptaculis complanatis vel interdum inflatis, alte bifidis, plerumque acuminatis, ob plantae magnitudinem comparative amplis; conceptaculis comparative amplis numerosisque.

Growing on sandstone in the upper littoral region. Near Empire, Coos Bay, Oregon.

Type, Gardner, no. 2785 (Herb. Univ. Calif., no. 201196), May, 1914.

One becomes somewhat exasperated in attempting to deal with such forms as the one above. Ordinarily it might be considered a depauperate form of some other well developed and characteristic form. There were several square rods of fruiting plants like those represented on plate 38 growing on very gently sloping sandstone near high-tide level. There were no other plants growing near, and there was seemingly no reason why, from the standpoint of anchorage, they should not grow much farther down in the littoral belt. The reduced size could not be due to superabundance of fresh water, for several much larger forms were found growing from three to six miles farther up the bay where the water is much less saline. Many plants have well-developed mature receptacles.

Its general characters seem to favor its being grouped with *F. evanescens,* although it will fit practically as well into the *edentatus* group. I am placing it with the former until more can be learned of its life history.

Fucus evanescens f. **ecostatus** f. nov.

Plate 39

Frondes submembranaceae, 12–18 cm. altae, dichotomae vel subsecundae, luteolae, siccatae obscure brunneae, stipite et disco radicali fragilissimis; segmentis strictis, cuneatis, 5–12 mm. latis, puncto crescente inconspicuo, costa indistincta, fere ad lobos terminales evanida, alis tenuibus membranaceisque, cryptostomatibus paucis et inconspicuis; receptaculis variabilibus, inflatis vel complanatis, saepissime angustis, bifidis, acuminatis; conceptaculis inconspicuis.

Growing on sandstone, wooden floats, etc., in the upper littoral belt. Coos Bay, Oregon.

Type, Gardner, no. 2791 (Herb. Univ. Calif., no. 201217), May, 1914.

Forma *costatus* is quite abundant at various localities from the mouth of Coos Bay up to its headwaters where several streams of fresh water flow in. This form seems to be definitely fixed, and does not appear to grade into any of the forms that are found growing outside of the bay. More investigation, however, may show that it is only a depauperate form of some definite species; on the other hand, it may prove to be a distinct species. It varies considerably in size and width of the fronds. The receptacles, though mostly pointed, are at times wide and blunt; at least there are specimens growing in the same habitat which have the same general characters but differ only in the character of the receptacles, and in such cases the segments are generally wider. They are connected, however, by almost imperceptible gradations. The size of the plants may be somewhat influenced by the substratum, mostly wood and soft sandstone, neither of which is suited to holding plants for a very great length of time. They usually do not persist in such localities beyond a single fruiting period. If the vanishing of the midrib is to be considered as having any diagnostic value, this form eminently belongs with the *evanescens* group. The midrib in some specimens is scarcely discernible in any part of the frond, and in all it vanishes in the terminal segments.

Fucus evanescens f. **oregonensis** f. nov.

Plate 40

Frons distincte caulescens, 15–20 cm. alta, subcoriacea, inferne dichotoma, superne subsecunda, luteola; segmentis angustis, sublinearibus vel paululum cuneatis, 4–7 mm. latis, flaccidis, levibus, costa angusta inferne evidente, superne parum evanida, cryptostomatibus parvis, inconspicuis, 20–25 in quoquo cm. quadrato; receptaculis tumidis, distincte definitis, quam segmentis ea gerentibus multo latioribus, integris aut bifidis, late fusiformibus, apicibus, valde obtusis; conceptaculis paululum conspicuis.

Growing on floats, piles, stones, etc., in the middle and upper littoral belts. East side of Coos Bay, opposite North Bend, Oregon.

Type, Gardner, no. 2786 (Herb. Univ. Calif., no. 201197), May, 1914.

This form seems decidedly distinct from all other forms previously described. Judging from its size, color, character of the midrib and its general consistency, its nearest relatives are to be found in the *evanescens* group, and close to forma *flabellatus* of this paper. The plants

are smaller, segments narrower and regularly dichotomous instead of subsecund, and the receptacles are shorter and blunter. The only locality from which it has been reported is the one given above; there it grew in profusion. Doubtless it may be found at other localities on the same bay.

Fucus evanescens f. **dendroides** Stroem.

"F. evanescens suberectus, rigidus, stipite validissimo, trunciformi, basin versus incrassato, longe denudato, in costam supra sensim evanescentem abeunte; fronde flabelliformiter dichotoma, segmentis angustissimis, 2–8 mm. latis, mediis costa prominente alatis summis ecostatis; receptaculis fusiformibus—anguste siliquaeformibus, 1–3 cm. longis, interdum furcatis, minus verrucosis."

Stroemfelt, Om Alg.-veg. vid. Islands Kuster, 1886, pp. 35, 36, pl. 3. The type locality is Seley, Iceland.

Fronds distinctly caulescent, dense, coriaceous, 7–15 cm. high, rigid, terete at the base and for some distance among the main branches, tapering upward, the narrow alae having worn away leaving only the much enlarged midrib, flabellate-dichotomous, in part subsecund, profusely forked, dark olive green to olive brown, black on drying; segments strict, somewhat contorted, narrow, 5–8 mm. wide in depauperate specimens, cuneate to slightly linear, widest at the truncate apices, growing point slightly depressed, midrib prominent, percurrent; cryptostomata sparse or entirely absent; receptacles very abundant, single, retuse to bifurcate, subfusiform to ovoid, considerably swollen, 1–3 cm. long; conceptacles numerous, emitting relatively long fascicles of paraphyses.

Plate 41

Growing on rocks exposed to fairly heavy surf, in the upper and middle littoral belts. Agattu Island to Sitka, Alaska.

Townsend, nos. 5755, 5756 (Herb. Univ. Calif., nos. 99105, 99106), Agattu, Alaska; Gardner, no. 2227 (Herb. Univ. Calif., no. 201148), Sitka, Alaska; Setchell and Lawson, no. 4052 (Herb. Univ. Calif., no. 99095, sub *Fucus evanescens* f. *bursiger*), Summer Bay, Alaska (cf. Setchell and Gardner, 1903, p. 285).

Stroemfelt, *loc. cit.*; De-Toni, Syll. Alg., 1895, p. 203; Setchell and Gardner, Alg. N.W. Amer., 1903, p. 284.

I first observed this plant in June, 1910, growing at Sitka, Alaska. A considerable area near the upper tide limit was completely covered with specimens. The plants were repeatedly branched, fruiting profusely, had a relatively large and strong holdfast and stipe, and varied from 7 cm. to 15 cm. in height. Some of the plants of Setchell and Lawson, referred to above, are only 4 cm. high, those of Townsend are

15 cm. to 18 cm. high. Stroemfelt does not mention the height of the type in his diagnosis, but his illustration, natural size, is 14 cm. high. The size of our plants, their narrow contorted segments, the character of the receptacles, the large firm holdfast and dendroid habit, agree so well with the description and figures of Stroemfelt as to leave little room for doubt as to the affinity of the two. Comparison with the type material may, however, show that the two sets of plants are distinct, as Stroemfelt does not mention the cryptostomata nor the caecostomata, nor does he mention the color, which is very striking in our plants. As the plants hang on the rocks after the receding tide, the shape, appearance, color, and abundance of receptacles reminds one of settled swarms of Italian bees.

Fucus evanescens f. **marginatus** f. nov.

Plate 42

Frons distincte caulescens, 20–50 cm. alta, regulariter et multo dichotoma, evidenter rigida coriaceaque, valde contorta, luteola, siccata olivaceo-brunnea, stipite tereti, superne inter ramos diminuante; segmentis 9–15 cm. latis, strictis, supra axillas non angustatis truncatis, vulgo linearibus, costa paululum prominente, parum evanida, alis inaequaliter attritis, cryptostomatibus fere absentibus; receptaculis 1.5–3 cm. longis, definitis, integris aut alte bifurcatis, anguste ellipticis, in margine dispositis; conceptaculis valde prominentibus.

Growing on rocks in the middle littoral belt. Sitka, Alaska.

Type, Gardner, no. 3997 (Herb. Univ. Calif., no. 201163), July, 1917.

The distinguishing characters of this form are absence of conceptacles from a complete margin of the receptacle, particularly of the rounded terminal portion, coupled with extreme sparsity of both cryptostomata and caecostomata.

It is difficult to decide to which species this form is most closely related. It has evident affinities with *Fucus evanescens* Ag. and with *F. spiralis* L. Its color and consistency, coupled with the slightly vanishing midrib in the terminal segments, seem to ally it with *F. evanescens*, but, if allied with this species, it would be through f. *dendroides* of Stroemfelt as its nearest relative. I have not seen the type nor any authentic specimens of f. *dendroides*, but since no one has questioned the validity of the form as belonging to *F. evanescens*, I am retaining it as such and grouping certain Alaska specimens with it. The narrow, rather long, considerably contorted and profusely branched

fronds, the blunt and somewhat fusiform receptacles, and the dendroid habit certainly suggest its close similarity with f. *dendroides*. However, I am inclined to keep it distinct on account of its decidedly more robust habit, the practical absence of cryptostomata, the much lighter color than that of the other forms within our region which I have placed with f. *dendroides*, and the distinctly marginal receptacles.

Fucus spiralis, although, for modern usage, imperfectly described by Linnaeus, has relatively recently been taken up by a number of algologists to include certain forms on both the European and the American shores of the Atlantic. Kjellman (1883, p. 202) definitely recognized it as a species, segregating, as new, f. *borealis*. In 1890, however, he changed his conception of the species and named it *F. Areschougii*, segregating f. *nana*. De-Toni (1895, p. 207) recognized *F. spiralis* as a valid species and reduced Kjellman's *F. Areschougii* to synonym. Börgesen (1902, pp. 472–477) followed De-Toni, and in a clear discussion reduced also *F. platycarpus* Thuret to a form of *F. spiralis*. Howe (1905, p. 581), after having examined the specimens in the Linnaean Herbarium supposed to represent Linnaeus' conception of *F. spiralis*, agrees with Börgesen's conception with regard to the validity of *F. spiralis*, considering as the typical form no. 234 of Collins' distribution from Maine in the Phycotheca Boreali-Americana sub *F. Areschougii*, and recently, in a letter to me, he states that he is inclined to place under this species most of the American plants which have previously passed for *F. platycarpus* of Thuret. Cotton, in Clare Island Survey, 1912, has kept up the name for certain forms in that locality. It seems thus to be quite well established as a species; the limits of variation, however, and the exact number of forms which should be grouped with it, have not yet been agreed upon. So far as I can learn, the name has not yet been used to designate any Pacific Ocean forms. Forma *marginatus*, under discussion, has some characters which might well link it with *F. spiralis*. It has the characteristically twisted segments in the upper part of the fronds, and the margined receptacles figured by Börgesen (*loc. cit.*), but the specimens of *spiralis* to which I have had access usually show an abundance of cryptostomata emitting fascicles of relatively long paraphyses, decidedly different in this respect from our plants. They also have shorter and more rounded receptacles and alae wider in proportion to the length of the segments.

Fucus evanescens f. **flabellatus** f. nov.

Plate 43

Frondes 15–25 cm. altae, subcoriaceae, subdichotomae vel partim secundae, pallide brunneae vel luteolae, disco radicali parvo, stipite parvo, 2–3 cm. longo; segmentis linearibus vel paululum cuneatis, 10–15 mm. latis, strictis, apicibus rotundatis, parum truncatis, alis comparative tenuibus, costa infra receptaculis paullo diminuata, cryptostomatibus paucis, parvis, inconspicuis; receptaculis fusiformibus, 2–3.5 cm. longis, integris aut bifurcatis, obscure definitis.

Growing on sandstone ledges in the middle of the littoral belt. Bellingham, Washington.

Type, Gardner, no. 2334 (Herb. Univ. Calif., no. 201168), July, 1910.

The majority of the plants seem scarcely mature at this season of the year, but enough of them were selected that appeared mature to be fairly certain that the measurements given for the receptacles are sufficiently accurate. The distinguishing character of the form is the pronounced fan-shape of the whole frond when spread out, and particularly of groups of segments, due to the secund method of branching.

The cryptostomata are relatively few and inconspicuous, and there is approximately the same number of caecostomata; thus in this character the form is on the border line between *F. evanescens* and *F. furcatus*. Probably the tendency is in the direction of the degeneration of these organs. The other characters, however, seem sufficiently well represented to ally it with *F. evanescens*.

Fucus evanescens f. **intermedius** f. nov.

Plate 44

Frondes foliaceae, flaccidae, 12–18 cm. altae, obscure brunneae vel luteolae, siccatae castaneae disco radicali et stipite parvis, angulis latis, rotundatis; segmentis linearibus, supra axillas diminuatis, 1–2 cm. latis, cryptostomatibus 12–25 in quoquo cm. quadrato, costa angusta, percursa, alis comparative latis, membranaceis; receptaculis basi latis, 1–2-furcatis, acuminatis aut acutis, complanatis vel muco inflatis, distincte definitis; conceptaculis parvis, numerosis.

Growing on rocks in the middle of the littoral belt. East Sound, Orcas Island, Washington.

Type, Gardner, no. 2333*b* (Herb. Univ. Calif., no. 205692), July, 1910.

This forms seems unmistakably connected, through its narrow forms, with *F. evanescens* f. *costatus* on one side, and, on the other

side, through its widest specimens, it seems not unlike certain narrow specimens of *F. evanescens* f. *pergrandis*. It differs from the former in having wider segments not perceptibly reduced in width, as in f. *costatus*, above the forkings, and in having wider, much more robust and blunt receptacles. From the latter it differs in being much less robust throughout, in having fewer cryptostomata and in having much more delicate and membranaceous alae.

Fucus evanescens f. **macrocephalus** Kjellm.

Plate 46

"f. fronde caulescente; segmentis linearibus, subcoriaceis, 5–6 mm. latis, costa parum prominente; receptaculis sublimitatis, magnis, 2.5–3.5 cm. longis, 1.5–2 cm. crassis plus minus turgidis, vel simplicibus ellipsoideis vel semel furcatis, cuneatis, ramis subcylindricis, apice rotundatis; scaphidiis magnis."

"Beringön, ymnig; sälskaplig inom litoralregionem tillsamman med föregående; med receptakler.'

Kjellman, Om Beringh. Algflora, 1889, p. 34.

Fronds subcaulescent, 12–18 cm. high, subcoriaceous, dark brown below varying to light brown or yellowish above; segments linear to slightly cuneate, 5–12 mm. wide, midrib well developed, percurrent, alae rather thin, cryptostomata absent or sparce; receptacles distinctly delimited, complanate in part, but mostly very tumid and mucilaginous, light yellow, 2–3.5 cm. long, 1–2 cm. wide, simple, retuse, or bifid; conceptacles conspicuous.

Plate 45

Growing in the middle of the littoral region. Bering Sea to Juneau, Alaska.

Newhall and Rhodes, nos. 5791, 5792 (Herb. Univ. Calif., nos. 99112, 99113), Cape Dyer, Alaska; McGregor, no. 5689 (Herb. Univ. Calif., no. 99114), Dutch Harbor, Alaska; Setchell and Lawson, no. 4077 (Herb. Univ. Calif., no. 99120), Amaknak Island, Alaska; Setchell and Lawson, no. 5152 (Herb. Univ. Calif., nos. 99116, 99119), Orca, Alaska; Gardner, no. 2230*a* (Herb. Univ. Calif., no. 201134), Juneau, Alaska.

Kjellman, *loc. cit.;* De-Toni, Syll. Alg., 1895, p. 202; Saunders, Alg. Harriman Exp., 1901, p. 432, pl. 62, fig. 1; Setchell and Gardner, Alg. N.W. Amer., 1903, p. 282.

Saunders (1901, p. 432) reports this form as growing at Puget Sound, Annette Island, Wrangell, Juneau, Sitka, Glacier Bay, Prince William Sound, Cook Inlet, Kukak Bay, and Shumagin Islands, and states: "This is the most abundant seaweed on the northwest coast." I have not been able to examine any of the specimens of Saunders'

collections, if such exist. There are no numbers quoted, and hence I will not attempt to place them. Most of the plants, particularly of the southern portion of the range, undoubtedly belong to f. *magnificus* of this paper. The illustration (*loc. cit.*) might well represent f. *macrocephalus*, but it was not stated whence the specimen was collected. Kjellman's type specimen is illustrated on plate 46. It shows a plant with practically all the segments fruiting simultaneously, and the description calls for a plant relatively small, with narrow segments, 5–6 mm. wide. Plants which have been placed under this form are mostly very much larger in all parts, as well as differing in other respects. I doubt if the form should be considered as extending farther south than Juneau, Alaska, where it intermingles with forma *magnificus*. I have illustrated a plant from Juneau on plate 45, which I consider to be fairly typical. It is somewhat more robust than the type, and many of the receptacles are obcordate. The form is quite abundant at Juneau.

Fucus evanescens f. **pergrandis** Kjellm.

Plate 47

"F. evanescentis forma thallo 30 ctmr et ultra alto, 1–2 ctmr lato, subcoriaceo, dichotomo, segmentis elongatis, costa parum prominente, receptaculis inflatis vel complanatis, indivisis, oblongo- ellipsoideis vel dichotomis, segmentis ovatis vel ellipsoideis."

"Fairhavn et Mosselbay in fundo pluriorgyali."

Kjellman, Om Spetsb. Thall., II, 1877*a*, p. 3.

Fronds caulescent, robust, subcoriaceous, up to 40 cm. high, regularly dichotomous, dark brown below to yellowish brown above, black on drying; segments elongated, linear to slightly cuneate, 1–2 cm. wide, midrib distinct, percurrent, cryptostomata varying from none to 20 per sq. cm.; receptacles numerous, mostly complanate, occasionally inflated, mucilaginous, 1–2.5 cm. wide, 2.5–4 cm. long, entire to bifid; conceptacles numerous, large.

Plate 48

Growing on boulders in the middle and upper littoral belts. Unalaska, Alaska, to Puget Sound, Washington.

Setchell and Lawson, nos. 3284, 4049 (Herb. Univ. Calif., nos. 99125, 99124), Amaknak Island, Alaska, and in Collins, Holden, and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. XLVI, sub *F. platycarpus;* Rev. Albin Johnson, no. 5701 (Herb. Univ. Calif., no. 99126), Yakutat Bay, Alaska; Gardner, no. 2230 (Herb. Univ. Calif., no. 201136), Juneau, Alaska; Townsend, no. 5773 (Herb. Univ. Calif., no. 99129), Kyska Island, Alaska; Butler and Polly, no. 20 (Herb. Univ. Calif., no. 99127), Port Renfrew, British Columbia.

Kjellman, *loc cit.;* De-Toni, Syll, Alg., 1895, p. 203; Setchell and Gardner, Alg. N.W. Amer., 1903, p. 284; Collins, Mar. Alg. Vancouver Island, 1913, p. 111.

The type locality of this form is Spitzbergen, where Kjellman says it grows at a depth of several fathoms. There are three fragments of the form in the Herbarium of the University of California, no. 132622, from Spitzbergen Islands, determined by Kjellman. These are represented on plate 36 and, although authentic, they do not entirely coincide with Kjellman's descriptions and type specimens as shown on plate 47. Apparently they are not representative specimens of this form. Plate 48 represents a form growing in the middle littoral belt at Juneau, Alaska, that coincides very closely with Kjellman's diagnosis and with plate 47 of his type specimen of forma *pergrandis*. A striking feature of the Juneau plants, however, is that practically every segment fruits at the same time. The Butler and Polly plant referred here is peculiar in being completely free from both caecostomata and cryptostomata. The Johnson plant referred here might be considered a very large specimen (45 cm. long) of *F. evanescens* f. *cornutus*, and the Kjellman plants have sterile segments. The simultaneous fruiting of the segments in the Juneau plant would indicate a much shorter fruiting season than in such forms as f. *magnificus*, in which only a few of the segments are fruiting at any one time. It would be of much interest to know how constant and reliable these characters of fruiting or non-fruiting of segments are as an aid to the determination of species.

Fucus evanescens f. **robustus** S. and G.

Plates 49 and 50

Fronds distinctly caulescent, 15–25 cm. high, much contorted, with distinct stout stipe and holdfast, dichotomous, terminal portions foliaceous, olive green to dark olive brown; segments broadly cuneate, terminal lobes rounded, 15–28 mm. wide, midrib distinct, slightly reduced near the apices, alae membranaceous, cryptostomata sparse; receptacles broad, oblong, ovate or obcordate, very variable in size, 1.5–3.5 cm. long, complanate, or much inflated, not mucilaginous, with distinct margin free from conceptacles which are large and projecting.

Growing on rocks in sheltered, shaded localities along extreme high-tide limit. St. Paul Island, Alaska, to Friday Harbor, San Juan Island, Washington.

Setchell and Gardner, Alg. N.W. Amer., 1903, p. 283. *Fucus platycarpus?* Setchell, Alg. Prib. Isl. 1899, p. 593.

The type specimen was collected by Miss Ida M. Rogers, no. 5724 (Herb. Univ. Calif., no. 99133), at Sitka, Alaska. The writer collected

it at Sitka in June, 1910, when it was in full fruit, and at Friday Harbor in July of the same year. The type and the two cotype specimens have all of the receptacles complanate, and are apparently immature (plate 49), but in the other collections mentioned many of the receptacles are much inflated (plate 50). The species is one quite free from mucilage as compared with other species of *Fucus* growing in the same localities but much lower down in the littoral belt. It seems to have become fixed as a form, and has the distinct habit, or character, of being able to persist in the upper two feet of the littoral belt, in which habitat it is necessarily uncovered the greater part of the twenty-four hours each day. It inhabits rock ledges, either steep or sloping, yet it is strictly confined to the upper, very narrow, belt. Its fronds are lighter and somewhat more fibrous than those of any other form.

Fucus evanescens f. **magnificus** f. nov.

Plates 51 and 52

Frondes foliaceae, 20–30 cm. altae, subcoriaceae, dichotomae, vel partim secundae, inferne obscure brunneae, superne luteolae, siccatae olivaceo-brunneae; segmentis comparative brevibus, linearibus vel cuneatis, plus minus contortis, 2.5–3.5 cm. latis, costa superne paululum evanida, cryptostomatibus variis usque ad 50 in quoquo cm. quadrato, vulgo paraphysum cristis exsertis quando juvenibus conspicuis; receptaculis distincte definitis, valde tumidis, mucosis, integris vel decomposite furcatis, truncatis vel acutis, latitudine et longitudine valde variis, vulgo flavis; conceptaculis numerosis valde conspicuis.

Growing in great profusion in the middle and upper littoral regions. Juneau, Alaska, to Puget Sound, Washington.

Type, Gardner, no. 2337 (Herb. Univ. Calif., no. 205690), Griffin Bay, San Juan Island, Washington, July, 1910.

So far as my observations extend, this form seems to be the most abundant of all the forms included in the above mentioned region. It varies quite widely in the shape of the receptacles as shown in plate 51. Some receptacles are simple, others decompositely furcate, many quite obtuse, others decidedly acute, but all are definitely delimited and swollen almost to the bursting point with mucilaginous substance. The segments are wide and foliaceous, not narrowing at the forkings, and the tendency to the strict habit of growth often makes them quite contorted.

One of the distinguishing characters is the sparsity of receptacles maturing at any one time. This habit, marked in only a few of our forms, should receive more study in the field. My opinion is that the

fruiting season extends over a much longer period than in most of the other forms. In the summer season, when I have observed them, one may find on the same individual receptacles varying from completely mature, to others just beginning to form, and many more sterile segments. The fronds fork. One branch of the dichotomy metamorphoses directly into a receptacle and the other continues to grow, and it in turn may fork one or more times without fruiting. This makes the mature receptacle appear to be lateral in origin, whereas in reality it originates just as all others do. This seems to be the condition prevailing in Thuret's *F. platycarpus*. Plate 16 in the Études Phycologique well illustrates this condition, but illustrates also another condition which does not seem to occur in f. *magnificus*, viz., that the suppressed fruiting segments are alternate, whereas in f. *magnificus* they are secund. I do not know how regularly the condition prevails in *F. platycarpus*, but this condition is too constantly prevalent in f. *magnificus* to be overlooked as a diagnostic character.

Fucus evanescens f. **stellatus** f. nov.

Plate 53

Frons distincte flaccida, vulgo contorta, 25–35 cm. alta, dichotoma vel subdichotoma, inferne pallide brunnea, superne luteola, siccata obscure olivaceo-brunnea, stipite et disco radicali comparative parvis; segmentis comparative brevibus, cuneatis, ad apices latioribus, 1.5–2.5 cm. latis, costa superne diminuante, cryptostomatibus paucis et inconspicuis; receptaculis distincte definitsi, complanatis, vel palulum tumidis, decomposite furcatis, vulgo patentibus acuminatisque, 3–4.5 cm. longis; conceptaculis numerosis, conspicuis.

Growing on boulders, logs, etc., in the lower littoral belt. Sackman's Point, near Tracyton, Kitsap County, Washington.

Type, Gardner, no. 2202 (Herb. Univ. Calif., no. 201144), May, 1910. *Fucus evanescens*, Tilden, Amer. Alg. (Exsicc.), no. 235, same locality as above.

Tilden's no. 235 seems to belong here, although the specimen in Professor Setchell's copy of her American Algae is only a fragment and just beginning to produce receptacles.

The distinguishing character of this form is the decompositely furcate receptacles, often widely divergent. As many as eight divergent apices have been observed with a common base. The fronds are decidedly flaccid and dissolve rather readily in fresh water after being dried.

Fucus evanescens f. **longifructus** S. and G.

Plate 54

Frond with short stipe and firm holdfast, somewhat caulescent below, foliaceous above, up to 45 cm. high, dark olive brown; segments long and narrow, strict, 1–2 cm. wide, midrib moderately conspicuous, slightly evanescent, cryptostomata absent or very sparse; receptacles usually complanate, not definitely delimited, 2–2.5 cm. wide, one to three times forked, with the divisions long, linear or sometimes recurved and pointed, up to 22 cm. long; conceptacles very large and scattered.

Growing on stones in the upper littoral belt. Orca to Juneau, Alaska.

Type, Setchell and Lawson, no. 5151 (Herb. Univ. Calif., no. 99110), Orca, Alaska. Collins, Holden, and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. 928; Setchell and Lawson, no. 5186 (Herb. Univ. Calif., no. 99109), Juneau, Alaska.

Setchell and Gardner, Alg. N.W. Amer., 1903, p. 283.

A cotype specimen of this very distinct form is illustrated on plate 54, and it features the distinguishing characteristics very well. It is unlike all other forms in the extremely long, linear-lanceolate, regular complanate receptacles, frequently spreading or recurved at the apices. In external appearance it approaches *F. furcatus* f. *rigidus*, but that form has an abundance of cæcostomata, the receptacles usually more decompositely furcate, and it is more cartilaginous. No. 5186 from Juneau is placed here with some doubts. If it should be placed here, it should be considered at the lower limit of variation in size.

Fucus evanescens f. **cornutus** Kjellm.

Plate 55

"f. segmentis inferioribus ad costas demum reductis, superioribus linearibus, subcoriaceis, angustis, 3–4 mm. latis, costa valida, at parum prominente; receptaculis sublimitatis, usque 4 cm. longis, 5–10 mm. crassis, turgidis, decomposito-furcatis, ramis inferioribus subcylindricis, summis subcoriaceis; scaphidiis magnis."

"Beringön, ymnig; tillsamman med de båda föregående formerna, bildande en individrik Fucus-formation; med receptakler."

Kjellman, Om Beringh. Algflora, 1889, p. 34.

Fronds subcoriaceous, 20–30 cm. high, regularly dichotomous, dark olive green to dark olive brown; segments strict, linear or very slightly cuneate in the narrower specimens, 5–8 mm. wide, apices truncate, midrib well developed, prominent, very slightly evanescent above, alae narrow, cryptostomata very sparse, small; receptacles distinctly

delimited, mostly complanate, simple or bifurcate, blunt to acuminate, apices slightly laterally reflexed, 2–4 cm. long; conceptacles numerous, conspicuous.

Growing on rock ledges in the lower littoral belt. Yakutat Bay, Alaska.

Rev. Albin Johnson, no. 5719 (Herb. Univ. Calif., nos. 99103, 99104), Yakutat Bay, Alaska.

Kjellman, *loc. cit.*; De-Toni, Syll. Alg., 1895, p. 202; Setchell and Gardner, Alg. N.W. Amer., 1903, p. 283 (in part).

This form was first discovered on Bering Island and described by Kjellman (*loc. cit.*). Comparison with a photograph of the type (cf. plate 55) and with a small portion of the type specimen seems to make it fairly certain that the two specimens collected by Albin Johnson, and cited above, are correctly placed, although they are much larger in all parts than Kjellman's description calls for. More study of material in the northern waters is highly desirable to make certain this determination. In neither the type nor the other material referred to is the cornute habit very pronounced.

Fucus evanescens f. **typicus** Kjellm.

Plate 56

"F. evanescentis forma antecedente minor, thallo 5–10 mm. lato, coriaceo, dichotomo, segmentis elongatis, costa plus minus prominente, receptaculis vulgo complanatis et dichotomis, segmentis obovatis."

"Forma inter omnes vulgatissima per totam oram occidentalem et septemtrionalem Insulae Vestspetsbergen in fundo vulgo 2–5 orgyali."

Kjellman, Om Spets. Thall., II, 1877*a*, p. 3.

Fronds 15–25 cm. high, coriaceous, dichotomous, dark brown; segments cuneate to sublinear, midrib moderately distinct, percurrent, cryptostomata few, small; receptacles mostly complanate, deeply furcate, segments obovate to linear-acuminate.

Growing on rocks in the upper littoral region. Harvester and Kakiak Islands, Alaska.

Setchell and Lawson, no. 5122 (Herb. Univ. Calif., no. 99136), Harvester Island, Uyak Bay, Alaska; Rigg, no. 100, Kadiak Island, Alaska.

Kjellman, *loc cit.*; Setchell and Gardner, Alg. N.W. Amer., 1903, p. 282.

Kjellman's type specimen of this form is illustraed on plate 56, and represents a plant considerably smaller than the plants which I

have allied with it from the Alaskan waters. No. 5122, in particular, is much more robust than Kjellman's description calls for. The receptacles are much longer and wider, but this may possibly be accounted for by difference in age. The plants collected by Rigg are smaller and more nearly coincide with the description. This plate shows Kjellman's plant to be about 10 cm. high, possessing distinct midribs in many of the segments, and to have relatively small receptacles. There is a plant in the Herbarium of the University of California, sheet no. 132618, contributed by Kjellman and collected on Spitzbergen in "1872–73," labeled in Kjellman's handwriting, "*Fucus evanescens* Ag.," which is almost a duplicate of the type specimen mentioned above. There is also a plant in the same herbarium, collected in 1868 from the same locality and determined by J. G. Agardh as *F. evanescens* Ag., whose fronds are about twice as wide as those of the Kjellman plants (cf. plate 56). Otherwise all of these three collections of plants are very much alike. The type specimen of *F. evanescens* Ag. is in the herbarium of J. G. Agardh at Lund under no. 00299. It has been examined by Professor Setchell, who states that the plant is slightly smaller than the plant referred to in Setchell and Gardner's Algae of Northwestern America, under f. *typica*, from Harvester Island, Alaska. This plant is in the Herbarium of the University of California under no. 99139. It differs only slightly from the wide form of *F. evanescens* from Spitzbergen, mentioned above, having more numerous, larger, and better developed receptacles. There is much greater disparity of size between this specimen and Kjellman's f. "*typica*" than there is between Kjellman's f. "*typica*" and his f. "*limitata.*" If we admit the specimen determined by J. G. Agardh from Spitzbergen as belonging with f. *typica* Kjellman, then the Harvester Island specimen which is so close to it had probably better be allied with it at present, until more is known of the forms from that island. However, it also seems very close to Kjellman's f. "*cornuta*," but has wider fronds and receptacles than the type specimen of that form.

I am referring here a series of plants collected on Kadiak Island, Alaska, by G. B. Rigg, no. 100. These plants are only slightly wider than the type specimen of Kjellman, and have numerous well developed receptacles. They appear to be the closest in all characters to the type, and I am taking them to be the best representatives of f. *typicus* thus far discovered in Pacific Coast waters.

Fucus evanescens f. **rudis** Kjellm.

Plate 57

"f. fronde caulescente; segmentis inferioribus valide costatis, cuneiformibus, superioribus coriaceis, costa plus minus prominente, 1–1.5 cm. latis; receptaculis maximis, inferne non limitatis, raro simplicibus, ambitu lineari ellipticis, vulgo plus minus decomposito-furcatis, segmentis sublinearibus; scaphidiis magnis."

"Fig. Fucus vesiculosus Post. et Rupr., Ill. Alg., t. 30."

"Beringön. ymnig; sällskaplig inom litoralregionen; med receptakler."

Kjellman, Om Beringh. Algflora, 1889, p. 34.

Fronds somewhat caulescent, coriaceous, dark brown, dichotomous; segments strict, cuneate, 1–2 cm. wide, reduced at the forking, terminal lobes truncate, midrib narrow but distinct to the apices, cryptostomata absent or rare; receptacles relatively large, 3.5–5 cm. long, rarely complanate, mostly very tumid and mucilaginous, not definitely delimited.

Growing in the lower littoral and upper sublittoral regions. Bering Sea to Skagway, Alaska.

Setchell and Lawson, no. 5121 (Herb. Univ. Calif., no. 99131), Harvester Island, Uyak Bay, Alaska. *Fucus evanescens f. macrocephalus,* Setchell and Lawson, no. 5178 (Herb. Univ. Calif., nos. 99117, 99118), Orca, Alaska; A. L. Bolton (Herb. Univ. Calif., no. 99115), Skagway, Alaska.

Kjellman, *loc. cit.*; De-Toni, Syll. Alg., 1895, p. 202; Setchell and Gardner, Alg. N.W. Amer., 1903, p. 282. *Fucus vesiculosus* Postels and Ruprecht, Ill. Alg., 1840, p. 12, pl. 25 (cf. Kjellman, *loc. cit.*).

Kjellman cites plate 30 of Postels and Ruprecht, Illustrationes Algarum, as representing this form. Plate 30 is labeled "*Constantinea rosa marina,*" but has in addition a small plant of *Fucus.* This plant has long, acuminate receptacles. Plate 25 of the same work, to which Kjellman probably refers, is labeled *Fucus vesiculosis* and has decompositely furcate receptacles with long, acuminate apices. The plants referred here by Setchell and Gardner (1903, p. 282) have the characteristic receptacles referred to above. Comparison with a photograph of Kjellman's type specimen hardly bears out his conclusion regarding the illustration in Postels and Ruprecht. The fronds are reduced in width above each forking. Some of the receptacles are relatively wide, others are very narrow, and those of Kjellman's type, which I have seen, are very blunt. Some doubts must be entertained as to the limits of this form. I am referring here plants from Orca and Skagway, cited above, as more nearly coinciding with Kjellman's type.

Fucus evanescens f. **irregularis** Kjellm.

"f. circa 15 cm. alta, fronde crebre irregulariter dichotoma, segmentis plurimis ad costas validas reductis, summis tantum alatis, angustis, obsolete costatis, apicibus truncatis; receptaculis limitatis ovatis, obovatis, oblongis vel obcordatis; scaphidiis minoribus."

"Beringön, sparsam; spridd inom litoralregionen; med receptakler."

Kjellman, Om Beringh. Algflora, 1889, p. 35.

A photograph of the type specimen indicates to me that this form, segregated by Kjellman on Bering Island, is hardly to be considered an entity but rather a battered and distorted plant of some other form. To my knowledge it has not been recognized since its original discovery; but if a valid form, it is quite likely to occur on the North American side of the Pacific Ocean, hence I am including it here as a possibility.

Fucus evanescens f. **limitatus** Kjellm.

Plate 58

"f. fronde caulescente; segmentis tenuioribus, submembranaceis, subdivaricatis, infimis cuneato-linearibus, superioribus sublinearibus, 3–5 mm. latis; costa parum prominente; receptaculis distincte limitatis, subpetiolatis vel simplicibus, ovato-ellipsoideis vel semel furcatis, ramis plus minus longis, divaricatis, apice rotundatis."

"S:t Lawrencebay, Port Clarence, på båda ställena temligen ymnig; något sällskaplig inom sublitoralregionen; med receptakler."

Kjellman, Om Beringh. Algflora, 1889, p. 34.

Fronds caulescent or subcaulescent, submembranaceous, dichotomous, spreading, with rounded angles, yellowish brown, darker brown on drying; segments short, cuneate-linear, apices rounded, truncate, midrib distinctly reduced upward, cryptostomata few; receptacles distinctly delimited, subpedicilate, seemingly lateral, entire or bifurcate, ovoid-ellipsoidal, 12–18 mm. long, 8–12 mm. wide.

Plate 59

Growing in the upper sublittoral belt. Port Clarence to Norton Sound, Alaska.

Kjellman, Port Clarence, Alaska; R. C. McGregor, no. 5683 (Herb. Univ. Calif., no. 99107), Besbora Island, Norton Sound, Alaska.

Kjellman, *loc. cit.*; De-Toni, Syll. Alg., 1895, p. 202; Setchell and Gardner, Alg. N.W. Amer., 1903, p. 282.

The only material of which I am aware that has previously been referred to this form since its establishment by Kjellman is that referred by Setchell and Gardner (*loc. cit.*) from Norton Sound, and the same material, two small fragments of plants, is again referred

here to the same form, though with some doubt. It is evidently a small form and, according to Kjellman, grows in the sublittoral belt, an unusual habitat for small forms, or even other forms outside of the Arctic regions. It may be noticed from the illustration (plate 59) that the Norton Sound specimens have a decided habit of growth which is not very common among the forms of the genus, viz., one of the members of a dichotomy develops into a receptacle, while the other continues to grow and forks one to several times before the receptacle of the original dichotomy matures and disintegrates. This makes the receptacle appear to have developed laterally. The illustration (plate 58) of the type specimen does not show this character, practically all of the segments fruiting simultaneously. More study of this character is highly desirable.

Fuscus evanescens f. **contractus** Kjellm.

"f. 5–10 cm. alta, fronde vix caulescente, subirregulariter furcata, segmentis subcoriaceis, infimis cuneato-linearibus, superioribus linearibus, 3–5 mm. latis, apicibus truncatis; costa inferne valida, prominente, superne evanescente; receptaculis limitatis, complanatis, minoribus, ambitu ellipticis vel obcordatis; scaphidiis parvis."

"S:t Lawrence-ön, temligen ymnig; något sällskaplig inom litoralregionen; med receptakler."

Kjellman, Om Beringh. Algflora, 1889, p. 34.

Fronds 5–25 cm. high, slightly caulescent, subcoriaceous, irregularly dichotomous or subsecund, dark brown to yellowish; segments mostly strict, cuneate-linear below, linear above, 3–10 mm. wide, apices truncate, midrib distinct below, vanishing above, cryptostomata moderately abundant, 15–20 per sq. cm., inconspicuous; receptacles complanate, distinctly delimited, 1.5–3.5 cm. long, ellipsoidal or obcordate, single or bifid; conceptacles few, but prominent.

Growing in the littoral region. Bering Sea, Alaska.

Setchell, nos. 5239, 5252 (Herb. Univ. Calif., nos. 99097, 99101), St. Michael, Alaska; McGregor, nos. 5673, 5679 (Herb. Univ. Calif., nos. 99099, 99100), Golofin Bay, Alaska. Not Gardner, no. 90 (Herb. Univ. Calif., no. 99096), Whidbey Island, Washington, sub *F. evanescens* f. *bursiger* (cf. Setchell and Gardner, 1903, p. 285).

Kjellman, *loc. cit.*; De-Toni, Syll. Alg., 1895, p. 202; Setchell and Gardner, Alg. N.W. Amer., 1903, p. 284.

Kjellman does not mention in his description of this form the decided and sudden difference between the width of the segments and the receptacles which they bear. This difference makes the receptacles appear stipitate, since they are over twice as wide at the base of the segments. Presumably this is the character upon which the form is based.

No. 5652 (Herb. Univ. Calif., no. 99101) from St. Michael, Alaska, quoted above, is as near the type as could be desired in every particular. The plants are about 10 cm. high, thus representing the upper limits in size as stated by Kjellman. The plants under the other numbers referred to are all larger in all parts than the measurements given by Kjellman, but they seem too closely linked to the type to warrant separation without further study of quantities of material in the field. There is not the sudden widening of the receptacles in any of the latter forms as in the type. The receptacle character seems more closely allied to that of f. *microcephalus.*

Fucus evanescens f. **angustus** Kjellm.

"Fuci evanescentis forma thallo subdichotomo, usque 20–30 ctmr alto et 4–5 mm. lato, coriaceo vel coriaceo-membranaceo, costa inferne valida, versus apicem sensim evanescente, in thalli partibus summis vix conspicua vel inconspicua, segmentis linearibus vel cuneato-linearibus, elongatis, cryptostomatibus numero variantibus, parum prominentibus, receptaculis minutis, oblongis, ovatis vel late ellipsoideis, obtusis vel acutis, inflatis vel plus minus complanatis, scaphidiis hermaphroditis, antheridiis interdum perpaucis; exsiccatione nigrescit."

"N. Gänse Cap; Rogatschew Bay."

Kjellman, Algenv. Murm. Meer, 1877, p. 27.

This form of *evanescens,* first described by Kjellman, has not been clearly identified with any specimens from our region, but is here included because of its close resemblance to certain of our forms, and hence the probability of its occurrence within our waters would seem to warrant its inclusion.

Yendo (1917, p. 16, pl. 1, fig. 1) identifies a plant of the Japanese waters with this form. Setchell and Gardner (1903, p. 284) also identified plants from East Sound and Fairhaven, Washington, with this form, and specimens from East Sound were distributed in Collins, Holden, and Setchell's Phycotheca Boreali-Americana, no. 926. On comparison of our plants with a sheet of plants in the Herbarium of the University of California, no. 132699, collected on the Vega expedition near Tjapka and contributed and labeled by Kjellman, *Fucus evanescens* f. *angustus,* it seems best to change the determination and to place our plants under *Fucus edentatus* f. *costatus,* under which a detailed account is given. The plants illustrated by Yendo differ decidedly from the Kjellman specimens referred to above, particularly in the size of the receptacles and the prominence of the midrib. It may be doubted whether this form really extends so far south on

either coast of the Pacific Ocean as was previously supposed, but its occurrence farther north may well be expected.

Fucus ceranoides f. *Harveyanus* (Dec'ne) Kjellman, collected and determined by De Alton Saunders at Pacific Grove, California, and distributed in Tilden's American Algae, no. 339, is *Hesperophycus Harveyanus* (Dec'ne) S. and G., *in* Gardner, Variation in Nuclear Extrusion, 1910, p. 127, and *in* Gardner, New Fucaceae, 1913, p. 317, pls. 36, 37.

In conclusion, it affords me much pleasure formally to acknowledge my sincere gratitude to Professor W. A. Setchell for encouragement and many valuable suggestions in the preparation of this work, to Dr. M. A. Howe and Dr. Carl Skottsberg for prints of photographs of type specimens, and to Mr. T. S. Brandegee for rendering the Latin diagnoses of the new species and forms presented here.

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1907. The Fucaceae of Japan. Jour. Coll. Sci. Imp. Univ. Tokyo.

EXPLANATION OF PLATES

PLATE 1, FIGURE 1

Fucus furcatus Ag.

A reproduction of the original in Icon. Alg. Ined., pl. 14. Natural size.

PLATE 1, FIGURE 2

Fucus evanescens Ag.

A reproduction of Agardh's original figure in Icon. Alg. Ined., plate 13. Seven-tenths original size.

Fig. 1

Fig. 2

PLATE 2

Fucus furcatus f. *typicus* Gardner

From a photograph of the type from herbarium specimens collected at Fort Ross, California, presumably the type locality of the species. One-third natural size.

PLATE 3

Fucus furcatus f. *typicus* Gardner

From a photograph of a living plant with immature receptacles.
One-half natural size.

PLATE 4

Fucus furcatus f. *angustus* Gardner

From a photograph of the type specimen showing a regeneration of one branch of the first dichotomy. Two-fifths natural size.

PLATE 5

Fucus furcatus f. *linearis* Gardner

From a photograph of a portion of the type specimen showing every terminal segment to be fruiting. About one-fourth of the original plant. One-third natural size.

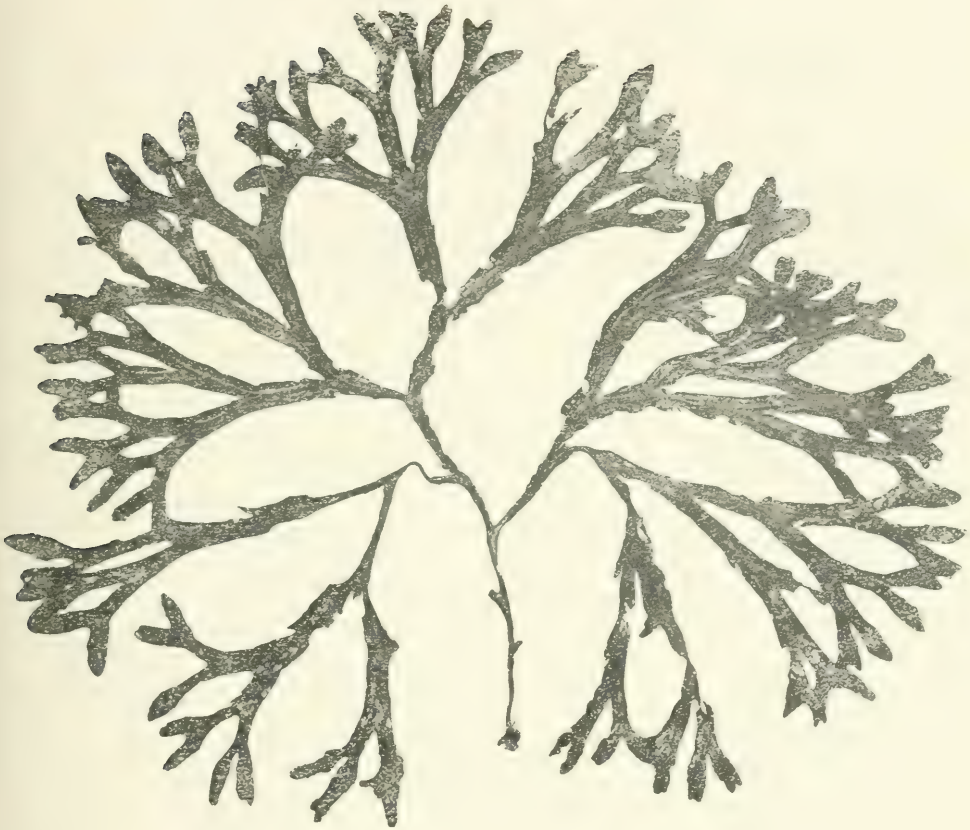

PLATE 6

Fucus furcatus f. *abbreviatus* Gardner

From a photograph of fresh material of the type specimen, showing relatively large, wide and scarcely matured receptacles. Three-fourths natural size.

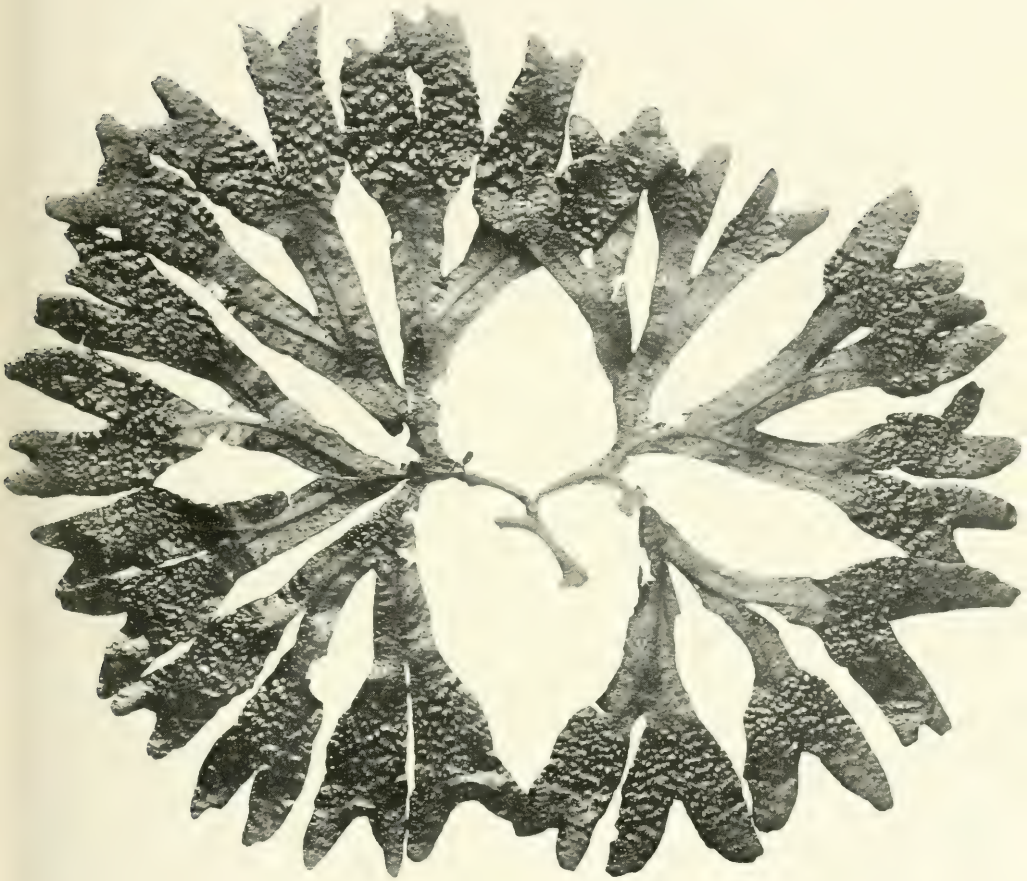

PLATE 7

Fucus furcatus f. *cornutus* Gardner

From a photograph of the type specimen. Two thirds natural size.

PLATE 8

Fucus furcatus f. *nigricans* Gardner

From a photograph of the type specimen. One-third natural size.

PLATE 9

Fucus furcatus f. *clonadus* Gardner

From a photograph of the type specimen. One-third natural size.

PLATE 10

Fucus furcatus f. *luxurians* Gardner

From a photograph of the type specimen, a young plant fruiting for the first time, showing many sterile terminal segments. One-third natural size.

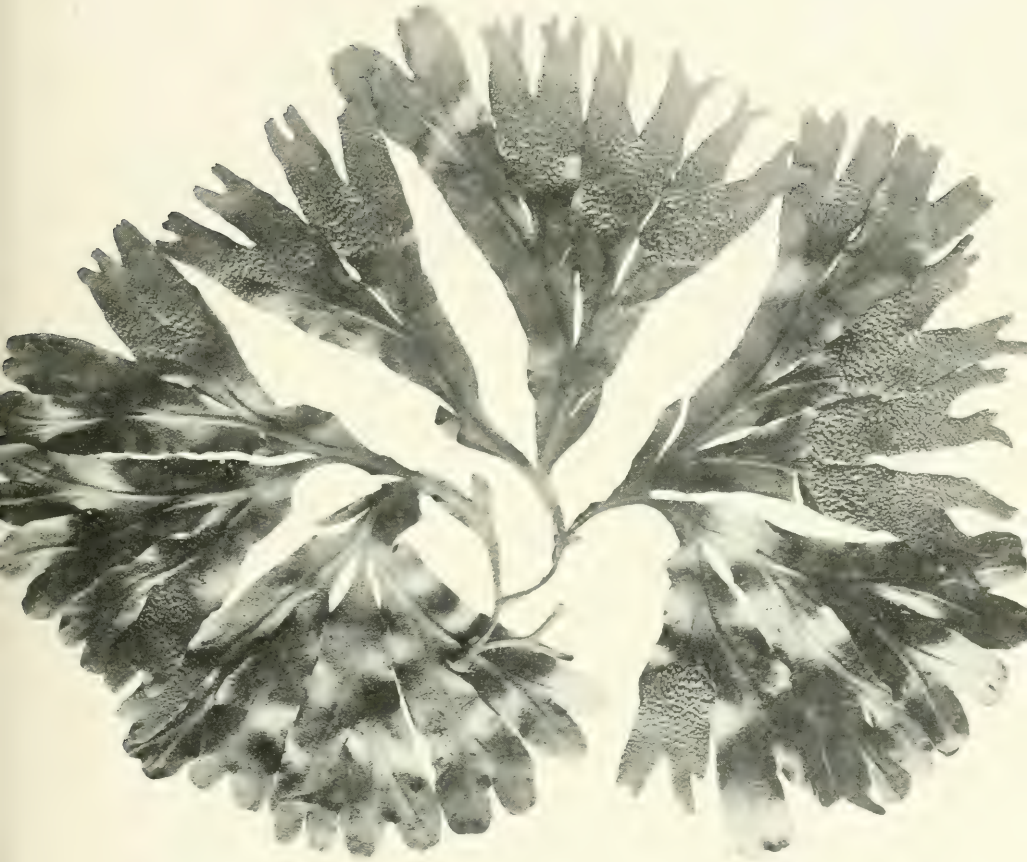

PLATE 11

Fucus furcatus f. *reflexus* Gardner

From a photograph of the type specimen. Two-fifths natural size.

PLATE 11*a*

Fucus furcatus f. *reflexus* Gardner

From a photograph of a cotype specimen showing some sterile segments.
Two-fifths natural size.

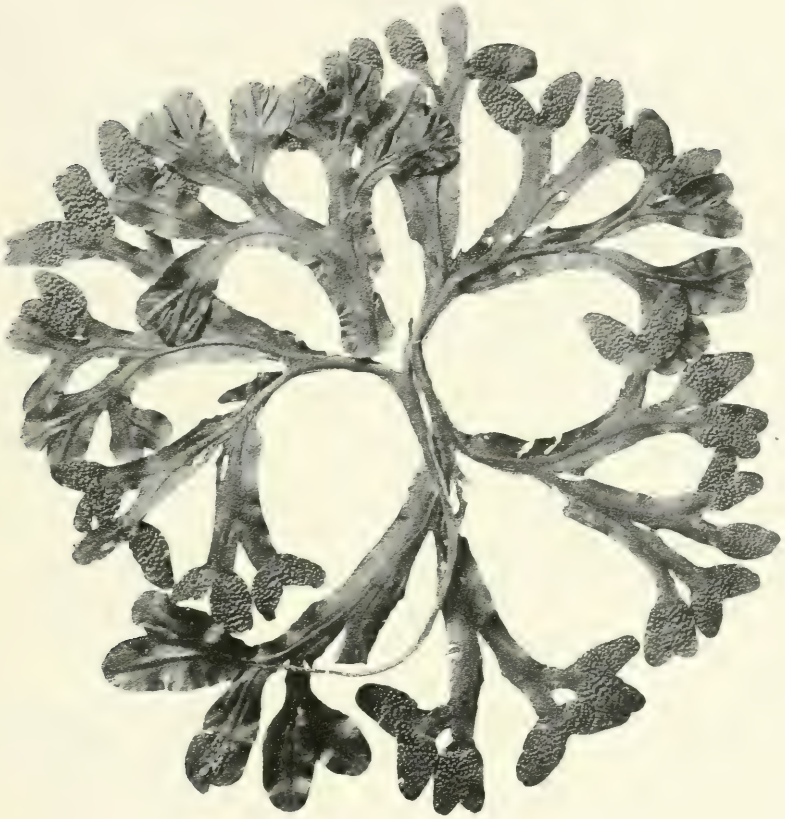

PLATE 12

Fucus furcatus f. *reflexus* Gardner

From a photograph of a sterile cotype specimen. Two-fifths natural size.

PLATE 13

Fucus furcatus f. *rigidus* Gardner

From a photograph of the type specimen. One-third natural size.

PLATE 14

Fucus furcatus f. *latifrons* Gardner

From a photograph of the type specimen, a young plant just beginning to fruit. Two-fifths natural size.

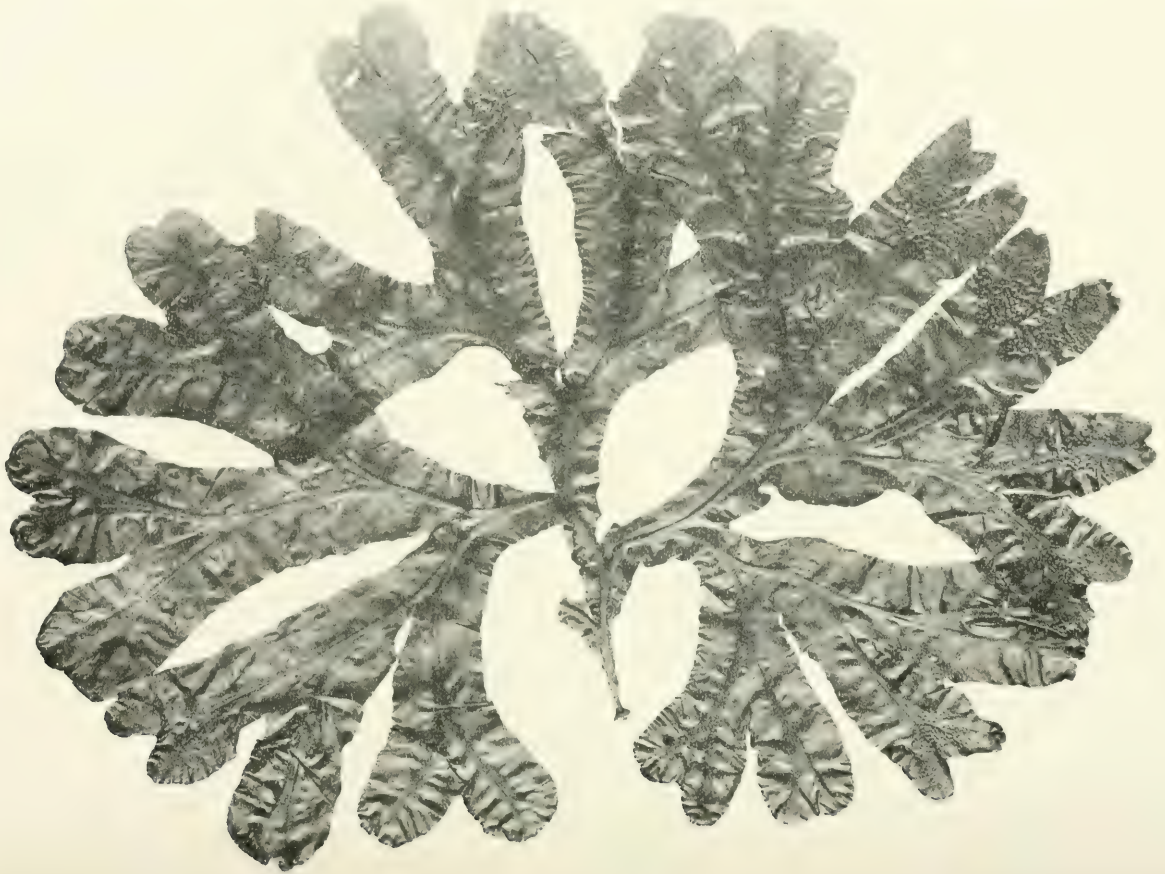

PLATE 15

Fucus furcatus f. *contortus* Gardner

From a photograph of parts of two dried plants. One third natural size.

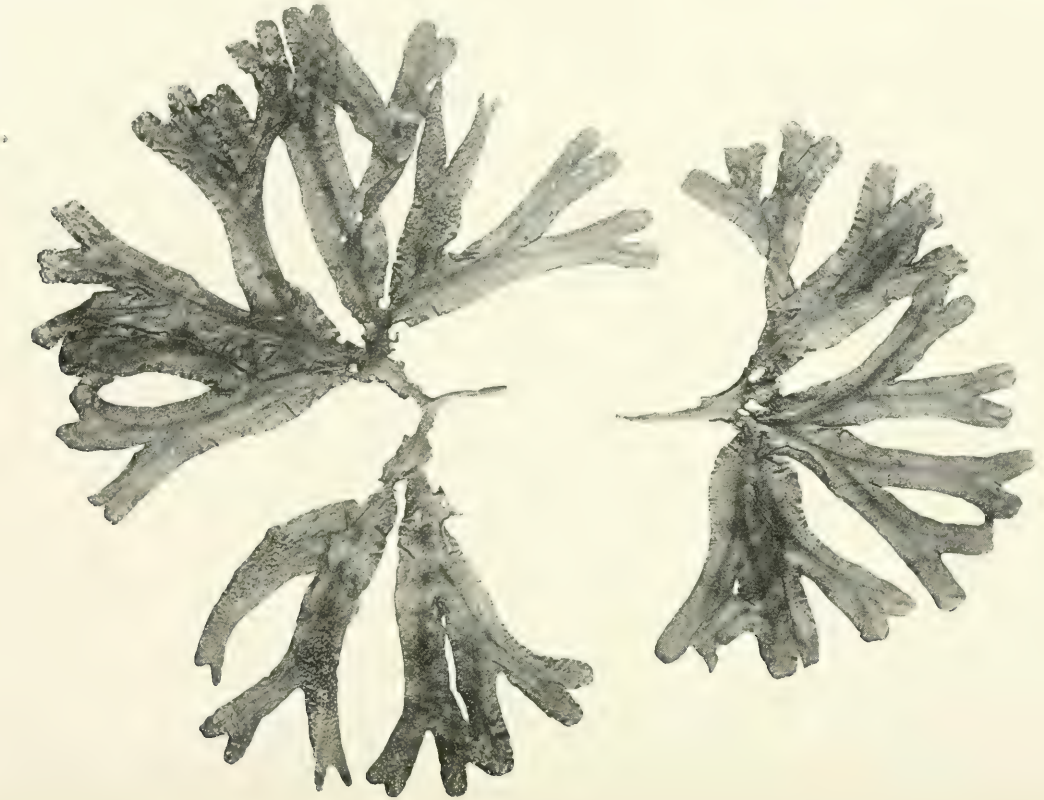

PLATE 16

Fucus furcatus f. *variabilis* Gardner

From a photograph of a variety of forms of receptacles.
One-half natural size.

PLATE 17

Fucus furcatus f. *variabilis* Gardner

From a photograph of a portion of the type specimen.
Two fifths natural size.

PLATE 18

Fucus nitens Gardner

From a photograph of a young plant with a few fruiting segments and characteristic vegetative segments. One-half natural size.

PLATE 19

Fucus nitens Gardner

From a photograph of the type specimen showing mature receptacles, mostly swollen. Two-fifths natural size.

In the explanation of plate 19, delete the word "type."

PLATE 20

Fucus inflatus f. *edentatus* (De la Pyl.) Rosenv.

From a photograph of a plant from the Faeröe Islands, determined by Börgesen. One-third natural size.

PLATE 21

Fucus edentatus f. *hesperius* Gardner

From a photograph of a portion of a plant, the type. One-third natural size.

PLATE 22

Fucus edentatus f. *divergens* Gardner

From a photograph of the type specimen. Three-eighths natural size.

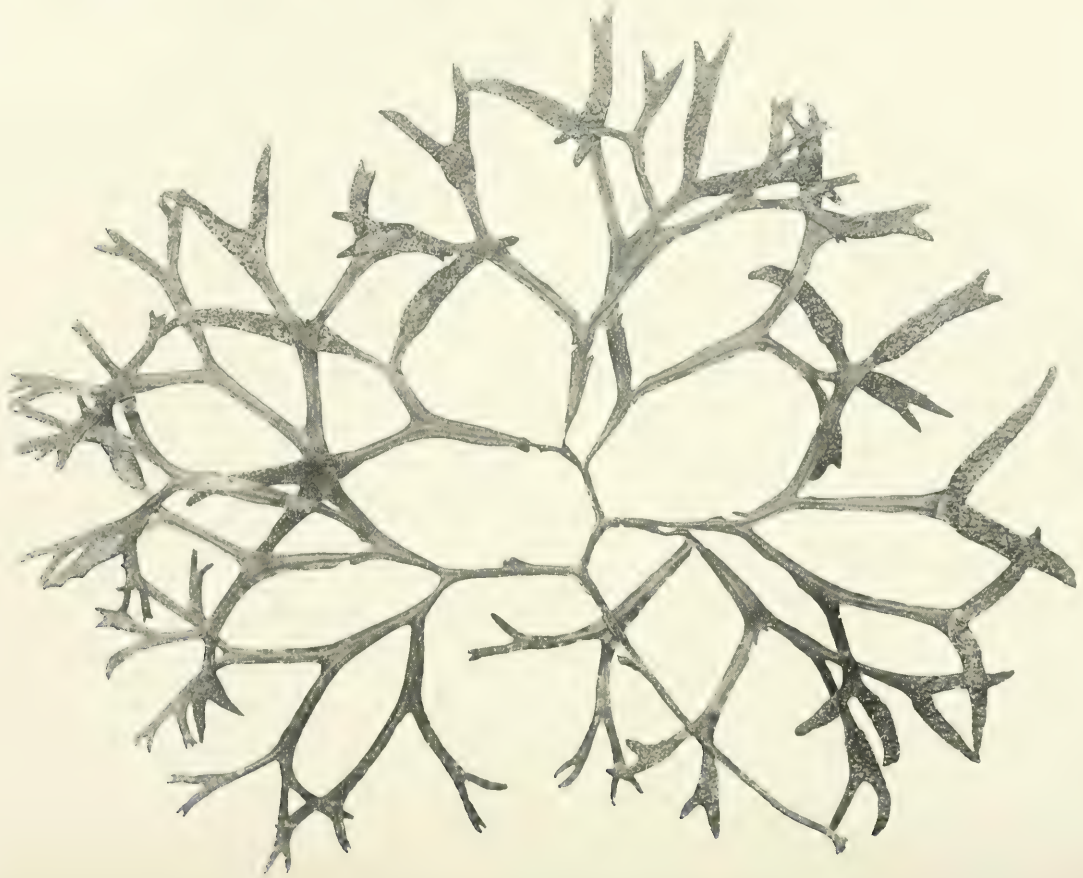

PLATE 23

Fucus edentatus f. *costatus* Gardner

From a photograph of the type specimen. Two fifths natural size.

PLATE 24

Fucus edentatus f. *costatus* Gardner

From a photograph of two plants, the smaller completely and the larger almost sterile. Two-fifths natural size.

PLATE 25

Fucus edentatus f. *acutus* Gardner

From a photograph of a plant. Two-fifths natural size.

PLATE 26

Fucus edentatus f. *divaricatus* Gardner

From a photograph of a fruiting plant. Three-fifths natural size.

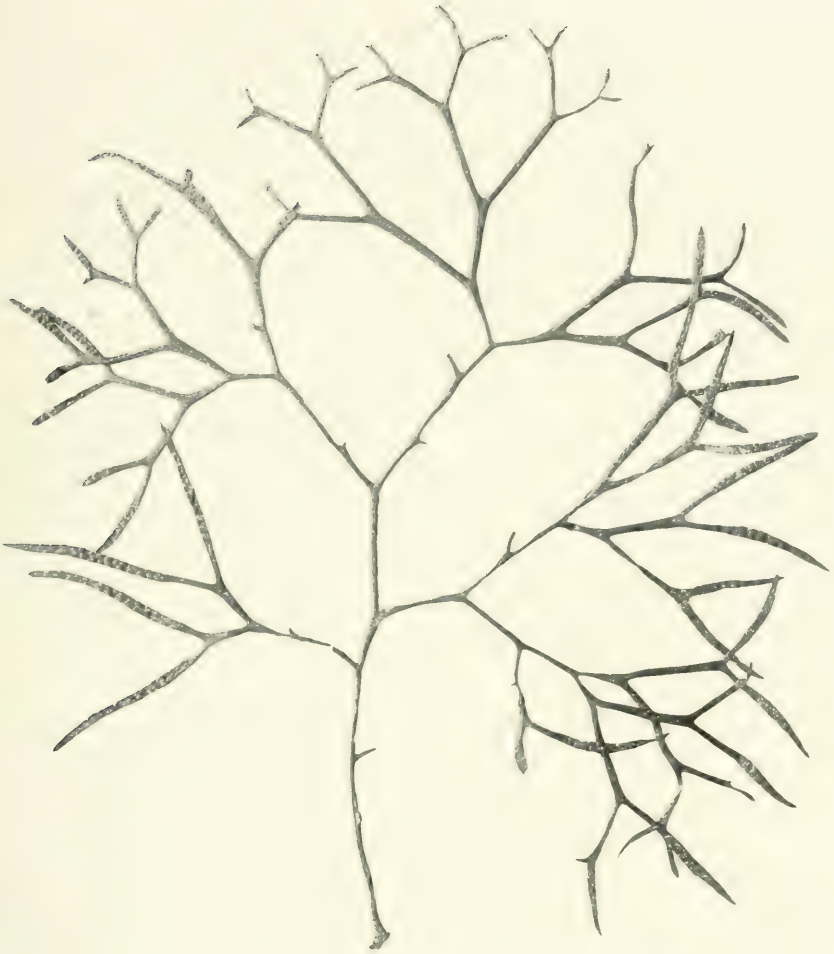

PLATE 27

Fucus membranaceus f. *abbreviatus* Gardner

From a photograph of one-half of a plant, the type. Two-thirds natural size.

PLATE 28

Fucus membranaceus f. *acuminatus* Gardner

From a photograph of the type specimen. One-half natural size.

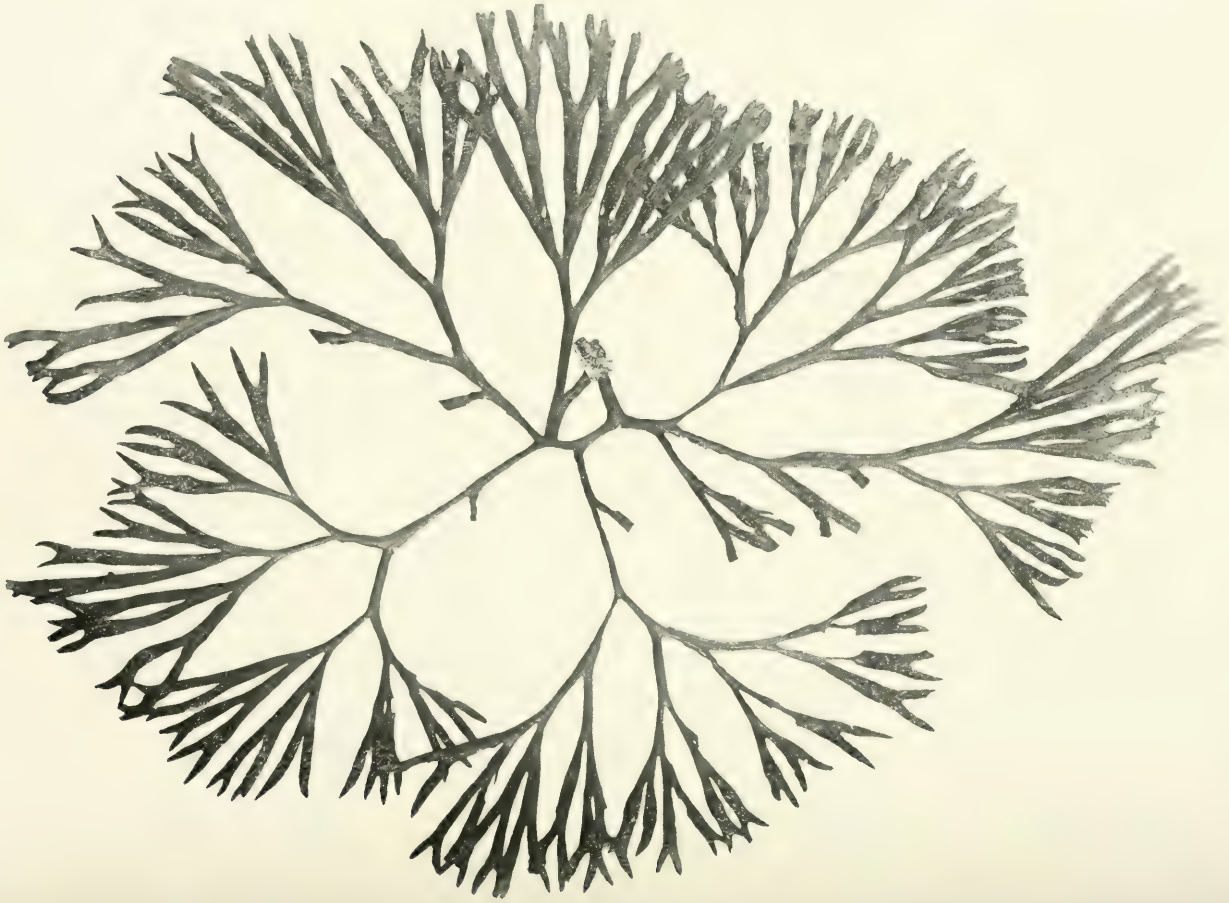

PLATE 29

Fucus membranaceus f. *obtusus* Gardner

From a photograph of the type specimen. One third natural size.

PLATE 30

Fucus membranaceus f. *typicus* Gardner

From a photograph of a sterile plant of the cotype.
Three-fifths natural size.

PLATE 31

Fucus membranaceus f. *typicus* Gardner

From a photograph of the type specimen. Three fifths natural size.

PLATE 32

Fucus membranaceus f. *limitatus* Gardner

From a photograph of the type specimen. Three-fifths natural size.

PLATE 33

Fucus membranaceus f. *latissimus* Gardner

From a photograph of portions of plants showing the character of the receptacles and sterile segments. One-third natural size.

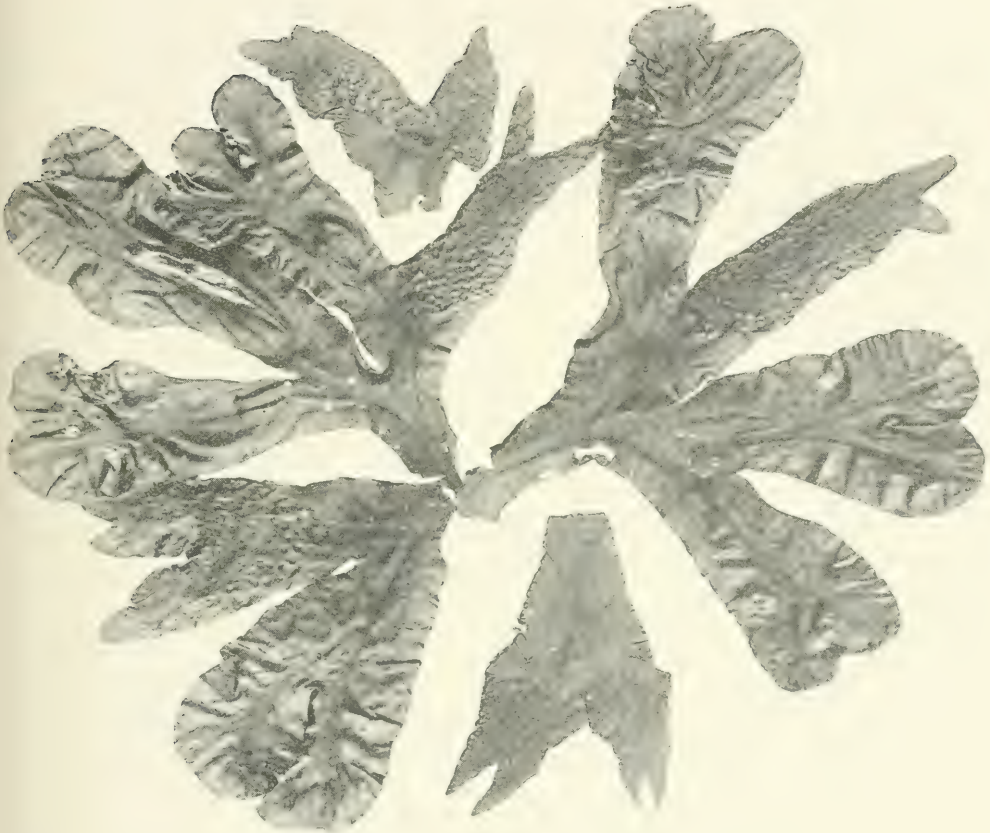

PLATE 34

Fucus membranaceus f. *latissimus* Gardner

From a photograph of the type specimen. One-third natural size.

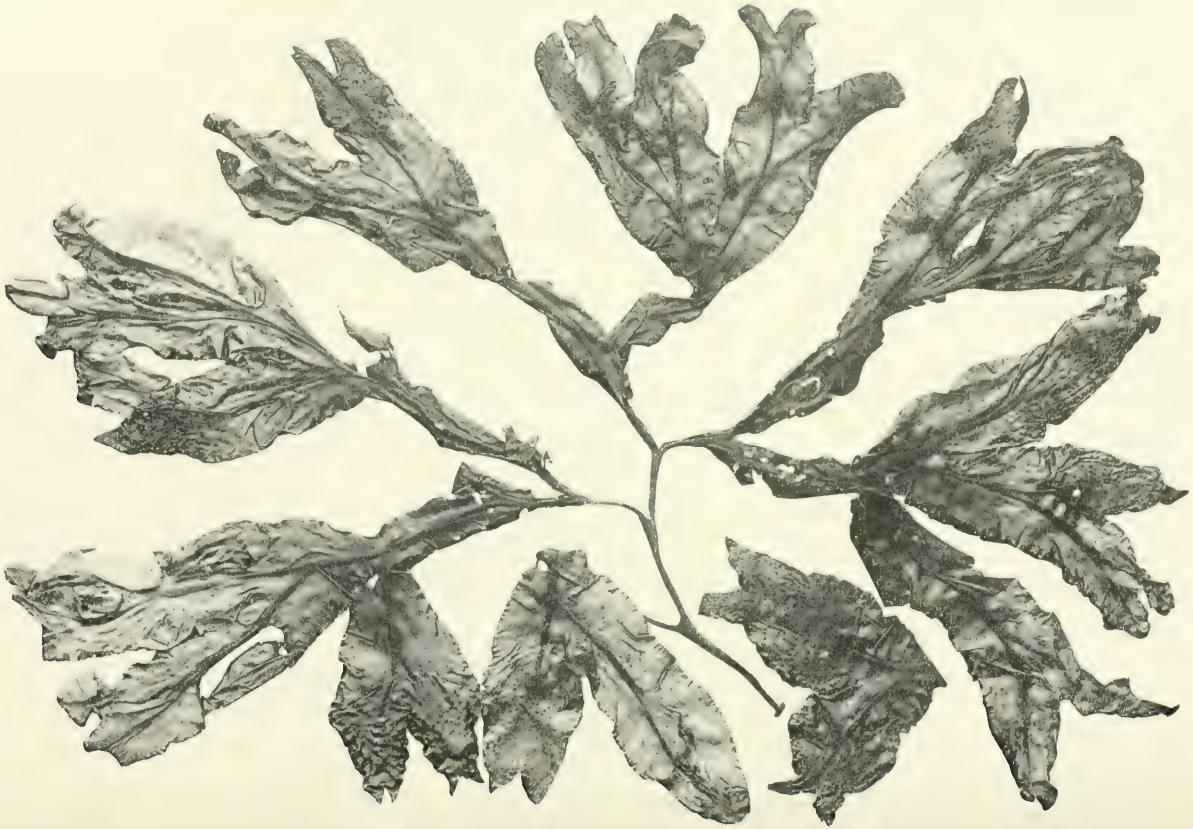

PLATE 36

Fucus evanescens f. *pergrandis* Kjellm.

From a photograph of fragments of dried plants. Two-thirds natural size.

PLATE 37

Fucus evanescens f. *vanus* Kjellm.

From a photograph of several whole plants. Two-thirds natural size.

PLATE 38

Fucus crassicaulis f. *cuneatus* Gardner

From a photograph of a group of plants in various stages of development. Two-thirds natural size.

PLATE 39

Fucus evanescens f. *costatus* Gardner

From a photograph of several parts of plants in various stages of development. One-third natural size.

PLATE 40

Fucus evanescens f. *oregonensis* Gardner

From a photograph of the type specimen. One-half natural size.

PLATE 41

Fucus evanescens f. *dendroides* Stroemf.

From a photograph of a whole plant, excepting the holdfast. Two-thirds natural size.

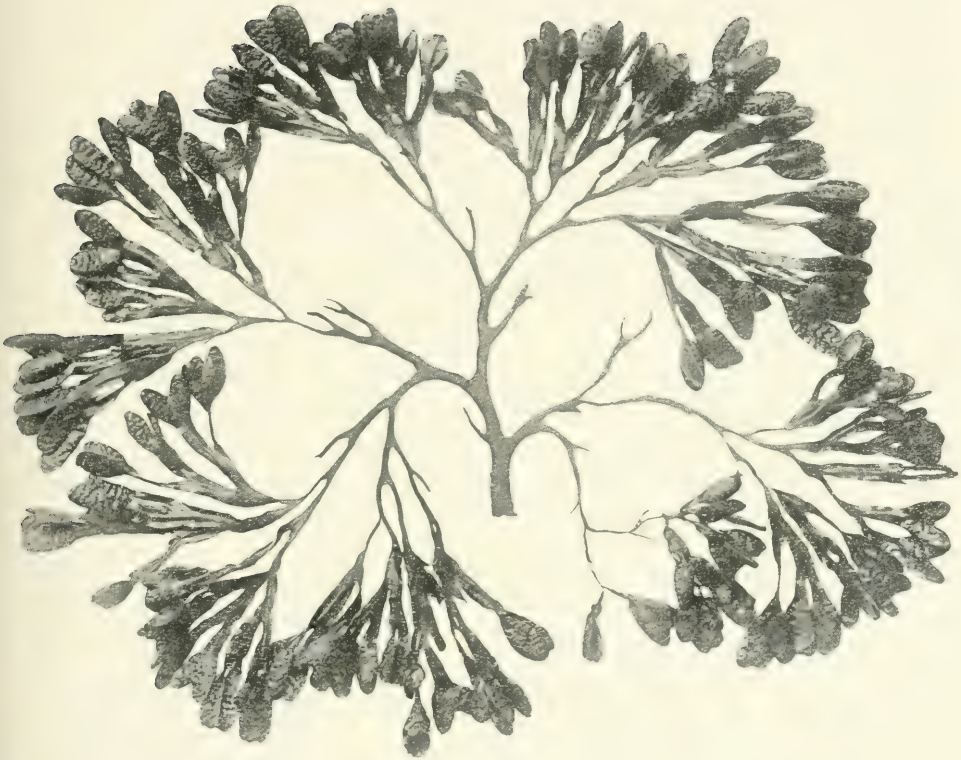

PLATE 43

Fucus evanescens f. *flabellatus* Gardner

From a photograph of the type specimen. Two-fifths natural size.

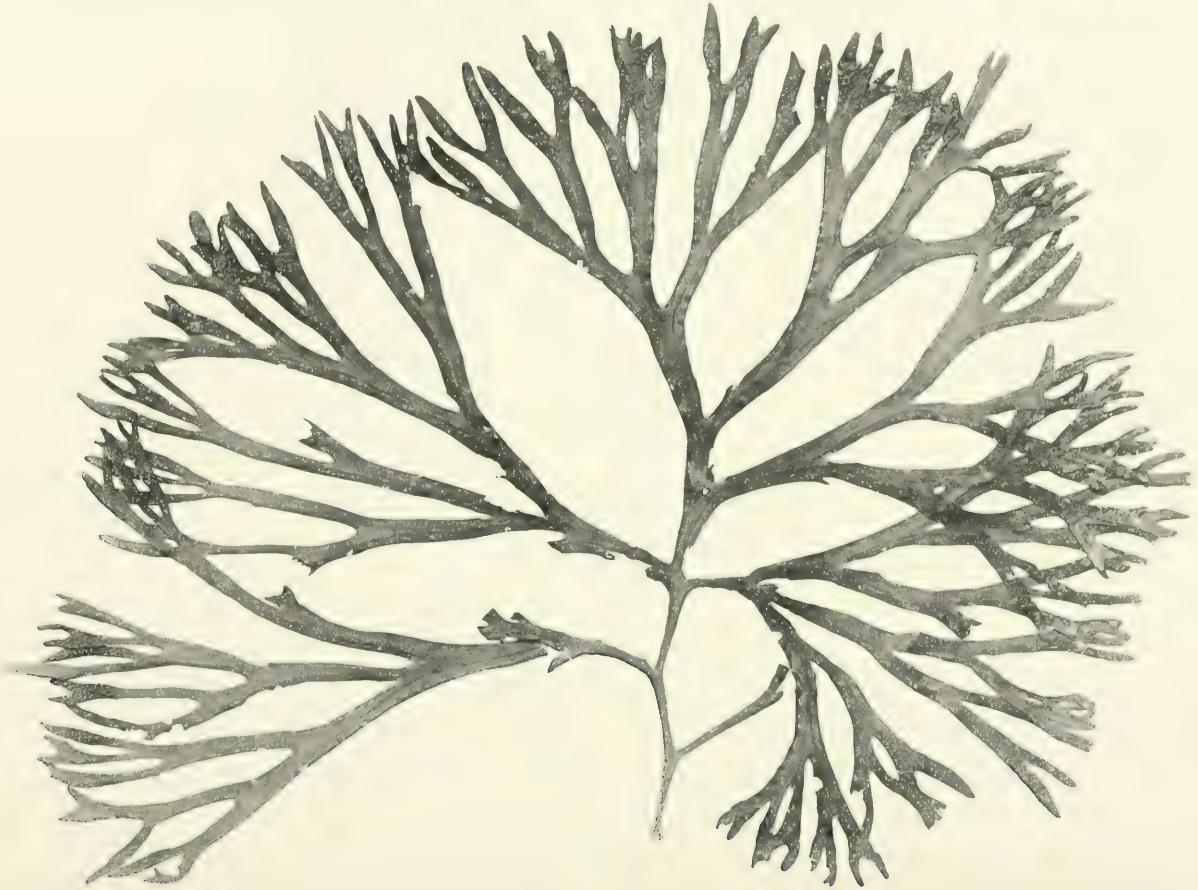

PLATE 44

Fucus evanescens f. *intermedius* Gardner

From a photograph of the type specimen. Two-thirds natural size.

PLATE 45

Fucus evanescens f. *macrocephalus* Kjellm.

From a photograph of portions of mature plants. One-half natural size.

PLATE 46

Fucus crancscens f. *macrocephalus* Kjellm.

From a photograph of Kjellman's type specimen. 1:1.8.

PLATE 47

Fucus evanescens f. *pergrandis* Kjellm.

From a photograph of Kjellman's type specimen. 1:1.8.

PLATE 48

Fucus evanescens f. *pergrandis* Kjellm.

From a photograph of a portion of a plant and a series of receptacles. One-half natural size.

PLATE 49

Fucus evanescens f. *robustus* S. and G.

From a photograph of the type specimen dried. One-third natural size.

PLATE 50

Fucus evanescens f. *robustus* S. and G.

From a photograph of a portion of a fresh plant. One-third natural size.

PLATE 51

Fucus evanescens f. *magnificus* Gardner

From a photograph of a group of receptacles. Two-thirds natural size.

PLATE 53

Fucus evanescens f. *stellatus* Gardner

From a photograph of the type specimen. One-third natural size.

PLATE 54

Fucus evanescens f. *longifructus* S. and G.

From a photograph of a cotype specimen. One-fourth natural size.

PLATE 55

Fucus crancscens f. *cornutus* Kjellm.

From a photograph of Kjellman's type specimen. 1:1.8.

PLATE 56

Fucus evanescens f. *typicus* Kjellm.

From a photograph of Kjellman's type specimen. 1:1.8.

PLATE 57

Fucus evanescens f. *radis* Kjellm.

From a photograph of Kjellman's type specimen. 1:1.5.

PLATE 58

Fucus evanescens f. *limitatus* Kjellm.

From a photograph of Kjellman's type specimen. 1:1.8.

PLATE 59

Fucus evanescens f. *limitatus* Kjellm.

From a photograph of two fragments of plants, showing the unequal growth of the various segments. Two-thirds natural size.

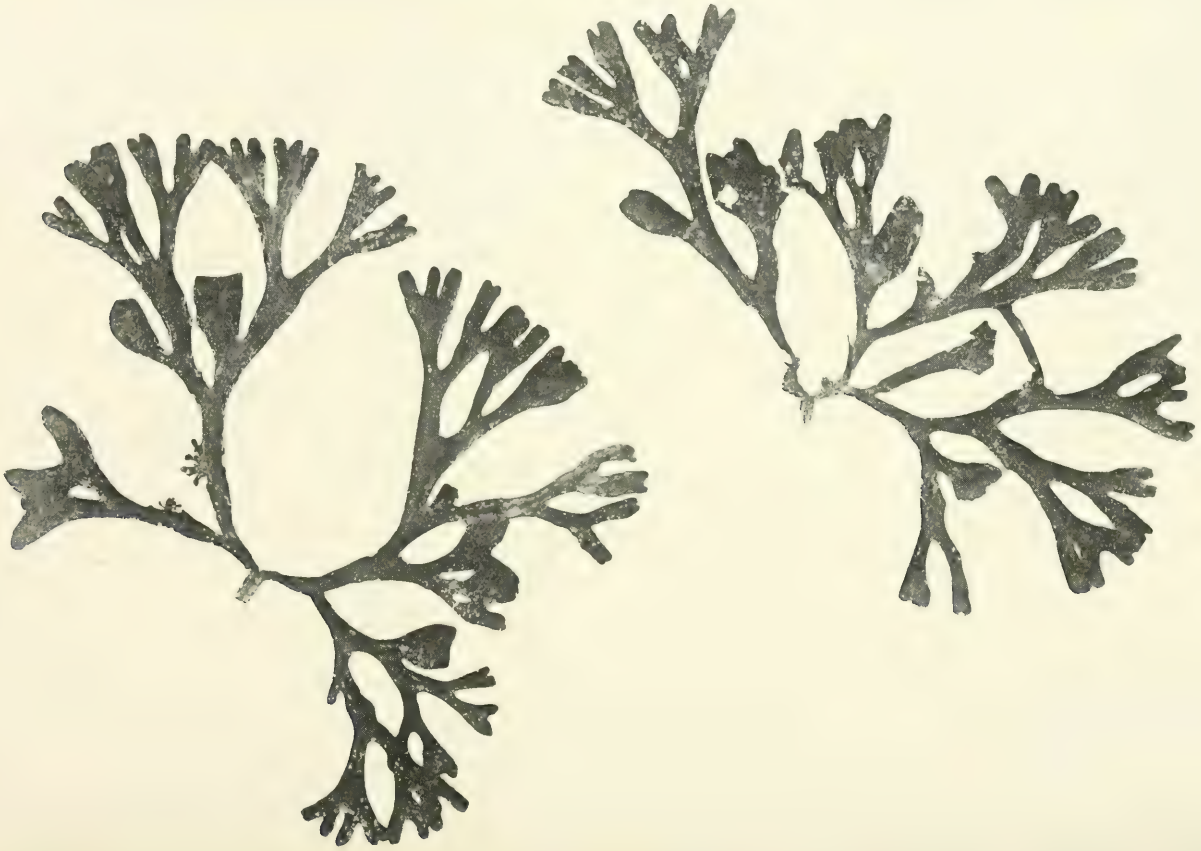

PLATE 60. FIGURE 1

Fucus edentatus De la Pyl.

From a photograph of the type specimen in the herbarium of the Paris Museum. About two-fifths the size of dried specimen.

PLATE 60. FIGURE 2

Fucus edentatus var. *angustior* De la Pyl.

From a photograph of a specimen in the herbarium of the Paris Museum. About two-fifths the size of dried specimen.

Fig. 1

Fig. 2

PLANTAE MEXICANAE PURPUSIANAE, XI

BY

TOWNSHEND STITH BRANDEGEE

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PLANTAE MEXICANAE PURPUSIANAE, XI

BY

TOWNSHEND STITH BRANDEGEE

Tradescantia heterophylla, sp. nov.

Ramosa, glabra: caulibus e radicibus fasciculato-tuberosis, plus quam 5 dm. altis: foliis anguste linearibus usque ad 15 cm. longis, nunc 1 cm. latis, nunc 2 mm. latis: floribus in umbellis terminalibus interdum axillaribus; pedicellis 1–3 cm. longis; pedunculis 4–6 cm. longis; staminibus consimilibus; filamentis inferne barbatis; petalis roseis sepala paululum superantibus; seminibus rugosis.

The pedicels of the umbel are sometimes divided and 2-flowered. Collected in the Cape Region of Baja California by T. S. Brandegee at Sierra El Taste, at Corral Piedra, and other localities. Type, Herb. Univ. Calif. No. 142035.

Gomphrena crassicaulis, sp. nov.

Erecta plus quam 4 dm. alta, ramosa: ramis et caulibus paululum hirsutis: foliis ovato-oblongis, apice acutis, basi in petiolum ca. 7 mm. longum angustatis, ca. 5 cm. longis, 1.5 cm. latis, utrinque appresso-hirsutis: spicis brevibus terminalibus vel axillaribus sessilibus ca. 1.5 cm. latis, foliolis ovatis acutis dense sericeo-hirsutis eis brevioribus involucratis; bracteis late ovatis acuminatis concavis; bracteolis quam bracteis 4-plo. longioribus, ca. 8 mm. longis, longe acuminatis albis, dorso valde cristatis, crista lacerata-dentata; segmentis perianthii lanceolatis quam bracteolis brevioribus; staminum tubo incluso; stylo tubo breviori, stigmatibus 2 linearibus.

This is a large plant of which the basal parts were not collected. It is near *G. Palmeri* according to its description. The bractlets are not indurated; the leaves are broadly oval, rounded, or obtuse at the apex; the crests are deeply lacerate rather than denticulate and the stamen tube is not exserted. Collected at Acasonica. No. 8907. Type, Herb. Univ. Calif. No. 205125.

Lonchocarpus dumetorum, sp, nov.

Ramis brunneis: racemis axillaribus terminalibusque usque ad 18 cm. longis; pedunculis ca. 1 mm. longis 1–2-floris quam pedicellis multo brevioribus: foliis ca. 15 cm. longis, 3–5-foliolatis; foliolis

utrinque glabris, oblongo-ovatis 4–11 cm. longis, 1.5–4.5 cm, latis, apice obtuse acuminatis: calyce 5-sinuato-dentato, albo-sericeo-pubescenti; vexillo suborbiculato, ca. 12 mm. lato, apice alte emarginato, flavido-punctato, dorso minute pubescenti, ochroleuco, ungui ca. 2.5 mm. longo; stamine vexillari basi libero; stylo curvato; alis flavido-punctatis violaceo-tinctis; ovario pubescenti, 5–10-ovulato; legumine immaturo, oblongo, membranaceo, glabro, 1–3-spermo, ca. 8 cm. longo, 1.8 cm. lato.

Three of the four collections are leafless. Collected at Remulatero, Vera Cruz. Nos. 8591 and 8588. Type, Herb. Univ. Calif. No. 20596.

Pithecolobium leucospermum, sp. nov.

Ramis brunneis lenticellis praeditis, flexuosis: foliis bipinnatis, pinnis 3–4-jugis; foliolis 8–10-jugis, oblongis, acutis, basi inaequalibus, utrinque paullo pubescentibus, rachidibus albo-pubescentibus, stipulis deciduis vel rare spinis validis instructis: floribus in capita congestis; pedunculis pubescentibus, 1–2 cm. longis, 1–2-axillaribus, glandulis plerumque deficientibus; calyce ca. 2 mm. longo, paullo pubescenti, breviter dentato; corolla ochroleuca, ca. 5 mm. longa, paullo pubescenti, apice breviter 5-loba; staminibus longe exsertis, basi ca. 2 mm. connatis; legumine coriaceo, fusco, glabro, paullo falcato, usque ad 20-spermo, 2-valvi, ca. 15 cm. longo, 7 mm. lato, intus septato; seminibus ovatis, pallide albis, nitidis; funiculo filiformi, contorto.

The egg-like seeds are different from those of most Mexican species of the genus. Collected in a barranca near Cameron, Vera Cruz. No. 8717. Type, Herb. Univ. Calif. No. 206765.

Mimosa chaetocarpa, sp. nov.

Fruticosa inermis: caulibus cinereis setosis: pinnis unijugis; petiolis ca. 8 mm. longis, hirsutis; stipulis lanceolatis ca. 3 mm. longis, setosis; foliolis pinnae 16–22 oblongo-obliquis, margine parum setosis, utrinque breviter setosis, apice obtusis mucronatis: floribus ut videtur siccatis purpureis, in capitulum congestis, 4-meris; pedunculis ca. 2 cm. longis, hirsutis, axillaribus: legumine juveni oblongo ca. 15 mm. longo, 5 mm. lato, apice mucronato, utrinque longe denseque setoso, setis stramineis albescentibus, ca. 3 mm. longis, 2–3-spermis.

The crowded densely setose pods are very conspicuous. Only fruiting specimens with remnants of old dried flowers were collected. Collected at Cameron, Vera Cruz. No. 8600. Type, Herb. Univ. Calif. No. 206733.

Calliandra mexicana, sp. nov.

Frutex ? ramis pubescentibus: pinnis 1-jugis; foliolis 2-jugis, fere glabris, oblique obovatis, apice apiculatis, 1-nerviis, ca. 14 mm. longis, 9 mm. latis, addito tertio saepe minori; petiolis usque ad 7 mm. longis, pubescentibus; stipulis brunneis, lanceolatis, ca. 4 mm. longis: capitulis globosis; pedunculis ca. 4 cm. longis, pubescentibus, ad axilis solitariis vel geminis: floribus rubris; calyce ca. 2–5 mm. longis, parum pubescentibus; corolla infundibuliformi, ca. 5.5 mm. longa; staminibus numerosis, ca. 3 cm. longis, basi in tubum corollam aequantem, connatis. Legumen deest.

A handsome species bearing large heads of red flowers and small shining leaves. Collected near Remulatero, Vera Cruz. No. 8726. Type, Herb. Univ. Calif. No. 214396.

Calliandra scopulina, sp. nov.

Frutex? ramis crassis glabris, lenticellis instructis: pinnis unijugis 5–6 cm. longis; foliolis 2–3-jugis glabris ovato-lanceolatis, terminalibus ca. 6 cm. longis, 1.5 cm. latis, inferioribus minoribus, apice acuminatis, basi cuneatis; petiolis 0.1–1.0 cm. longis: capitulis florum ad nodos vetustos pedunculis 3–5 mm. longis; corolla ca. 6 mm. longa, ochroleuca; filamentorum tubo corollae aequali. Legumen deest.

The heads of flowers are nearly sessile along the branches. Collected in a rocky barranca near Cameron, Vera Cruz. No. 8930. Type, Herb. Univ. Calif. No. 205119.

Bauhinia (Casparia) peninsularis, sp. nov.

Frutex ramosus, 2–3 m. altus: ramis brunneis fulvo-tomentosis: foliis apice obtusis ad tertiam partem bilobatis, basi cordatis, usque ad 5 cm. longis, 6 cm. latis, 7–9 nerviis, subtus tomentosis, supra glabris; petiolis ca. 1.4 cm. longis, tomentosis; petalis ca. 2 cm. longis, albis; ovario dense tomentoso: legumine glabro oblongo, utrinque acuto, ca. 8 cm. longo, 1.5 cm. lato; stipite ca. 2.5 cm. longo.

The cordate basal sinus is about as large as the emargination between the lobes of the leaflets. Collected in the Cape Region of Baja California by T. S. Brandegee, at Pescadero, at west side of Cape Region and at Buena Vista, No. 177. The specimens from the latter locality were listed as *B. porrecta* var.? Type, Herb. Univ. Calif. No. 137264.

Desmodium sylvicola, sp. nov.

Herbaceum, erectum, ramosum: caulibus striatis, glabris: foliis inferioribus trifoliatis; superioribus unifoliatis superne gradatim in bracteas nutantibus, utrinque glabris; foliolis ovato-acutis, usque ad 4.3 cm. longis, 2 cm. latis; foliolo terminali majori cum petiolulo 1.8 cm. longo; petiolulis foliorum latiorum 2–3 mm. longis; stipulis brunneis, striatis, ca. 4 mm. longis; stipellis filiformibus: inflorescentia laxe paniculata; calyce breviter uncinato-hirsuto; corolla purpurea; pedicellis pedunculisque breviter uncinato-hirsutis; bracteis sub floribus ovato-lanceolatis, ca. 5 mm. longis, breviter hirsutis; legumine breviter stipitato, glabro; articulis 4–5, ovato-orbicularibus, plerumque sibi invicem replicatis; isthmis centralibus.

Usually the legume resembles that of *D. plectocarpum* Hemsley but sometimes it is flat. The specimens do not show the height of the plant. Collected at Lochiapa, Vera Cruz, in rocky forests. No. 8658. Type, Herb. Univ. Calif. No. 208411.

Parosela longeracemosa, sp. nov.

Fruticulus plus quam 25 cm. altus ramosus: ramis juvenibus pubescentibus: foliorum rhachi ca. 1.7 cm. longa, pubescenti, indistincte glanduloso-punctata; petiolo pubescenti, ca. 1 cm. longo; foliolis oblongo-obovatis, primum puberulis demum supra glabris, subtus glanduloso-punctatis, ca. 7 mm. longis; stipulis subulatis, brevibus; racemis caules vel ramos terminantibus, laxifloris fructiferis demum usque ad 18 cm. longis, rachi pubescenti; calyce campanulato, villoso, eglanduloso, dentibus deltoideis brevibus margine albo-pubescentibus; vexillo late cordato, ochroleuco, ca. 6 mm. longo, quam carina purpurea breviori; alis purpureis: legumine apicem versus puberulo: bracteis calyce brevioribus ovato-lanceolatis, pubescentibus, deciduis.

Not sufficient quantity was collected for distribution. Collected at Minas de San Rafael, San Luis Potosi. No. 4839. Type, Herb. Univ. Calif. No. 148411.

Hiraea Purpusii, sp. nov.

Fruticosa: ramis brunneis: foliis coriaceis, ovatis vel obovatis, apice acutis, obtusis, vel emarginatis, basi truncatis vel cordatis, supra glabris, nitentibus, subtus praeter costam parum hirsutulam glabris, 7–12 cm. longis, 3–6 cm. latis; petiolis hirsutulis, ca. 5 mm. longis, interdum glandulam gerentibus: pedunculis ca. 8 mm. longis; pedicellis ca. 15 mm. longis, hirsutulis; sepalis ovatis, ca. 2 mm. longis, interdum glandulis concavis, stipitatis instructis; petalis flavis, margine denticulatis; samaris alis lateralibus, membranaceis, flabelliformibus, dorso crista instructis, alas includentibus ca. 2.2 cm. latis.

Usually only one samara develops. The plant is very floriferous. Collected at Cameron, Vera Cruz. No. 8731. Type, Herb. Univ. Calif. No. 214375.

Croton sitiens, sp. nov.

Fruticulus: ramis cinereis, glabris: foliis ovato-acutis, basi cuneatis, margine minute denticulatis, utrinque dense longeque stellato-hirsutis, venis ca. 4-jugis, ca. 15 mm. longis, 5 mm. latis, ad apices ramorum congestis; petiolis ca. 3 mm. longis; stipulis parvis; spicis terminalibus axillaribusque, monoicis ca. 1 cm. longis; bracteis ca. 1.5 mm. longis, ovato-lanceolatis, unifloris; floribus masculis 6–8, calyce ca. 2.5 mm. alto ad medium 5-fido, staminibus 5, filamentis glabris, petalis calycem aequantibus: flore femineo solitario, apetalo, calyce 5-partito, laciniis ovato-lanceolatis, ca. 4 mm. longis; ovario pubescenti; stylis profunde bifidis, laciniis paulo bilobis; capsula calycem aequanti, dense stellato-hirsuta; seminibus levibus.

The stamens, styles, and petals are often purple. Collected at Remulatero, Vera Cruz, growing on dry slopes. No. 8732. Type, Herb. Univ. Calif. No. 214369.

Miconia Purpusii, sp. nov.

Frutex: foliis in eodem jugo aequalibus, lanceolato-ellipticis, apice longe acuminatis, basi cuneatis, usque ad 15 cm. longis, 6 cm. latis, 3–5 nerviis, supra glabris, subtus interdum ad nervos paululum ferrugineo-tomentosis, margine breviter spinuloso-sinuato-dentatis; petiolis ca. 2 cm. longis; paniculis quam foliis brevioribus: calyce glabro urceolato ca. 3 mm. longo, limbo truncato persistenti; petalis 5, ca. 4 mm. longis; staminibus 10, antheris ca. 4 mm. longis in rimam dehiscentibus: bacca subglobosa 5-loculari.

The greater number of the many species of Miconia have anthers which open by terminal pores. This proposed new species belongs to the small group in which the anthers open by longitudinal slits. Collected at Mirador, Vera Cruz. No. 8903. Type, Herb. Univ. Calif. No. 205088.

Œnothera thalassaphila, sp. nov.

Ascendens vel decumbens suffrutescens: caulibus breviter pubescentibus usque ad 30 cm. longis, interdum decorticantibus: foliis ovatis integris apice acutis basi in petiolum ca. 1 mm. longum marginatum angustatis, dense albo-pubescentibus, ca. 1 cm. longis, 6 mm. latis: floribus axillaribus; sepalis ca. 1.7 cm. longis, e basi lata attenuatis longitudine petalis aequalibus, sparsim breviterque albo-pubescentibus; tubo ca. 4 cm. longo, pubescente; capsula ca. 3 cm. longa, pubescente quadrangulare curvata; seminibus oblongo-ovatis utrinque acutis, levibus.

This probably is the same plant as Xantus, No. 35 referred by Dr. Gray (Proc. Am. Acad., 5:158) to *Œ. sinuata* var. *humifusa* and by Dr. Watson (Rev. Œnothera, 1873:581) to *Œ. Drummondii.* In appearance it somewhat resembles *Œ. humifusa* but the flowers are much larger and the ovate leaves smaller. From *Œ. Drummondii* it differs by having a different pubescence and smaller leaves of a different shape. The stems are more woody than those of either of the two related species. Collected by T. S. Brandgee on the ocean beach of the Cape Region of Baja California at San José del Cabo and Pescadero and also at Rancho Tomate. Herb. Univ. Calif. Nos. 140659, 107673, 107674.

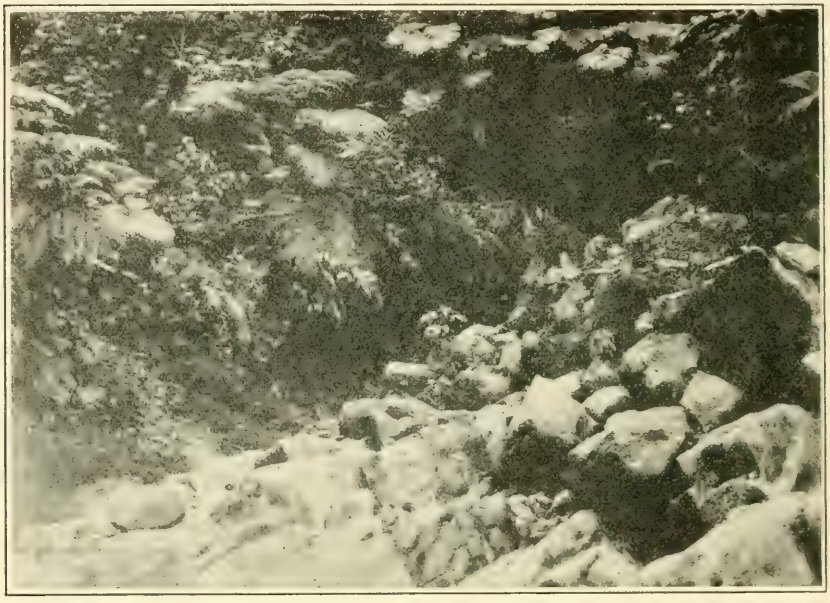

Fig. 1. *Gunnera mexicana* Brandg.

Gunnera mexicana, sp. nov.

Foliis chartaceis, latitudine valde variabilibus, prope apicem usque ad 14 cm. latis, ca. 32 cm. longis in petiolum brevissimum gradatim angustatis, apice grosse dentatis simul dentibus minoribus multis instructis, subtus ad costas breviter hirsutis venis hirsutulis: scapo plus quam 30 cm. alto: inflorescentia thyrsoidea ramulis ca. 10 cm. longis, fructibus subglobosis sessilibus ca. 1 cm. latis. Cet. ignota.

This extra limital species differs from the generic description in the shape of the leaves. The leaves in circumscription are rounded at

the top and attenuate into a very short petiole. The upper part is almost acutely lobed and also dentate. The midvein is often two or three times forked. The single specimen collected bears only mature fruit. Collected from wet rocks of the Sierra Madre near Misantla, Vera Cruz. No. 8568. Type, Herb. Univ. Calif. No. 206237.

Pachystelma cordatum Brandg.

Additional collections of this species from the type locality enable the fruit to be described.

Folliculi crassi, longe acuminati, tuberculoso-muricati, ca. 8 cm. longi, medio ca. 1.5 cm. lati.

Cordia ovata, sp. nov.

Frutex: ramis glabris: foliis alternis late ovatis, acuminatis, margine nunc repandis nunc breviter serratis nunc integris, ca. 5.5 cm. longis, 3.5 cm. latis, supra glabris, scabris, subtus praecipue ad venas paululum pubescentibus; petiolis ca. 1 cm. longis pubescentibus: floribus in cymis dichotomis, pedunculis pedicellisque pubescentibus; calyce ca. 4 mm. longo, anguste campanulato pubescenti, ca. 12-striato-costato, 5-dentato, costis interdum paulo excurrentibus; corolla infundubilari ca. 1 cm. longa, alba ut videtur siccata; antheris 5 inclusis; stylo 2-fido ramis breviter 2-fidis; drupa ossea 4-loculari.

The slightly bifid branches of the style are an important character. Collected at Remulatero, Vera Cruz. No. 8937. Type, Herb. Univ. Calif. No. 205972.

Physalis filipendula, sp. nov.

Annua: caulibus glabris, striatis, ramosis: foliis glabris, ovato-acuminatis, basi in petiolum ca. 5 cm. longum attenuatis; lamina usque ad 8 cm. longa, 6 cm. lata, margine sinuato-dentata: corolla ochroleuca, subrotata, diametro ca. 1.3 cm.; pedicellis ca. 1.2 cm. longis, parum furfuraceis: calyce fructiferi glabro, ovato-acuminato, ca. 3–4 cm. longo, 2.4 cm. lato; pedicello 4–6 cm. longo.

The long filiform pedicels of the large fruit furnish the most important character of the species. Collected by T. S. Brandegee in Baja California at San José del Cabo and on Sierra San Lazaro.

Stemmadenia calycina, sp. nov.

Fruticosus: ramis cinereis: foliis ovatis, vetustis supra glabris, subtus ad venas molliter pubescentibus, apice acutis, usque ad 8 cm. longis, 5 cm. latis, breviter petiolatis; calycis segmentis late ovatis, ca. 2 cm. longis, 1.5 cm. latis, glabris, obtusis, basi bracteis duabus inaequalibus suffultis; corolla infundibulari, ca. 5 cm. longa, flava; folliculis juvenibus divaricatis, acutis.

The calyx segments are much larger than those of *S. bella*, *S. tomentosa*, and *S. Palmeri* and have a different form. The upper part of the segments seems to become yellow with age. Collected at Remulatero, Vera Cruz. No. 8771. Type, Herb. Univ. Calif. No. 211882.

Roseanthus heterophyllus, sp. nov.

Monoicus: caulibus striatis glabris: foliis membranaceis trilobatis vel integris, basi cordatis sinu lato, utrinque sparse hirsutis, usque ad 13 cm. longis, 9 cm. latis, plerumque usque ad medium lobatis, lobis ovatis acutis denticulatis; petiolis ca. 3.5 cm. longis, sparsim hirsutis: pedunculo masculo ca. 8.5 cm. longo; flore 6.5 cm. longo, albo; fructu maturo ovoideo, glabro 3.5–5 cm. longo, 3–4 cm. lato, pedunculo 3.5 cm. longo.

The sinus at the base of the leaf is auricled by the blade. Collected in Barranca de Panoaya, Vera Cruz, climbing trees and rocks. No. 8636. Type, Herb Univ. Calif. No. 208377.

Apodanthera scaberrima, sp. nov.

Monoica: caulibus striatis, scaberrimis, setosis: foliis latioribus quam longis, fere ad medium 3-lobatis, utrinque setosis praecipue subtus, setis interdum e basi pustulata, usque ad 5 cm. longis, 6 cm. latis, basi leviter cordatis; lobis obtusis, margine denticulatis; petiolis 3–8 cm. longis, dense pustulato-setosis; cirrhis simplicibus: pedunculo masculo brevi 2–3-floro; calycis lobis ovato-lanceolatis; pedunculo femineo ca. 7 cm. longo, striato, pustulato; calyce pustulato-setoso; corolla ca. 7 mm. longa; staminibus 3, liberis; antheris rectis, una 1-loculari, duabus 2-locularibus, dorso corollae affixis; lobis acutis: fructu maturo ovoideo glabro, 4–5 cm. longo, 3 cm. lato; seminibus ellipsoideis utrinque acutis.

The lobes of the leaves are variable in shape and size. The whole plant is very scabrous. The specimens furnish only old pistillate flowers, young staminate ones, and a single mature fruit. Collected in Barranca de Panoaya, Vera Cruz. No. 8685. Type, Herb. Univ. Calif. No. 208381.

Transmitted November 3, 1922.

A REVISION OF THE CALIFORNIAN SPECIES OF LOTUS

BY

ALICE M. OTTLEY

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INTRODUCTION

In monographing the Californian species of *Lotus* one must consider first the limits of the species, and, second, the unity of the group and its relationships to Old World forms. The early publications of Bentham (1829, 1837), of Gray (1863), and of Watson (1876) dealing with American species are inadequate to meet the present needs, as the work of later students has resulted in the accumulation of much material, and in additions to the number of described species. The somewhat heterogeneous assemblage of American species is in many respects similar to the Old World group, but has been treated in diverse ways by the various authors. An *Enumeration of the North American Loti* was published by Greene in 1890. Although comparatively few species have been described since, the need of further investigation is still great, as Greene's diagnoses are commonly brief and practically ignore the variations present within many of the species.

Geographical Distribution

The New World *Loti* comprise a large group of species, limited, almost without exception, to western North America, extending from British Columbia to Mexico and Lower California, but, in one case, reaching as far south as Chile. Only one native species has been cited for the eastern, and one for the middle United States, the latter being abundant in the Pacific Coast states. More species are found growing in California than in any other one state. In the northern part of the state occur species common to British Columbia, Washington, Idaho, and Oregon; in the southern part and in the islands off the coast appear many species which occur also in Lower California; and in the eastern and southeastern parts, especially in the regions of the Mohave and Colorado deserts, are found several species whose range extends into Nevada, Arizona, and Mexico.

The Old World species of *Lotus* have a widespread geographical distribution. They are of most common occurrence in those parts of Europe, Asia, and Africa adjacent to the Mediterranean Sea, but they appear also in northern Europe, southern Africa, and montane Asia. In Australia the genus is represented by one indigenous species.

Development of the Generic Concept of the Genus *Lotus* in Its Relation to the New World Species

The American species first described were referred to the Old World generic type *Lotus*. They were *L. sericeus* Pursh, in 1814, and *L. subpinnatus* Lag., in 1816. The third species was described by W. J. Hooker as *L. pinnatus* in 1829. Later that same year, Bentham redescribed this species and named it *Hosackia bicolor* Dougl. making it the type of the new genus *Hosackia*. At the same time he described two other species for his new genus, *Hosackia decumbens and Hosackia parviflora*, and transferred *Lotus sericeus* of Pursh to *Hosackia*, assigning to it the binomial *Hosackia purshiana*. In stating his reasons for regarding the American plants as generically distinct from the Old World genus *Lotus*, Bentham says of *Hosackia bicolor* Dougl.

> This plant has much of the habit, as well as the inflorescence and fruit of a *Lotus*, to which Dr. Hooker has referred it in the *Botanical Magazine;* but independently of the characters which may be drawn from the position of the alae and the capitate stigma, the pinnate not ternate leaves, and the absence of the large foliaceous stipule of *Lotus*—characters which appear to be of importance among most of the Leguminosae * * * perhaps alone suffice for the adoption of the genus *Hosackia* proposed by Mr. Douglas.

Bentham found, however, as he became acquainted with an increasingly larger number of American species, that the characters which he had regarded as distinctive for *Hosackia* did not hold for all; and in 1837, retaining the name *Hosackia* for eleven species, he referred five (*L. subpinnatus* Lag., *L. macraei* Benth., *L. micranthus* Benth., *L. sericeus* Pursh, and *L.? unifoliolatus* Hook.) to the genus *Lotus* and created for these the section *Microlotus* characterized by plants having one-flowered peduncles and exstipulate leaves of three to five leaflets. Bentham and Hooker (Genera Plantarum, 1865) reduced two of these (*L. macraei* Benth. and *L. unifoliolatus* Hook.) to synonymy, retained the other three in the section *Microlotus* of the genus *Lotus*, and referred twenty-five other American species to the genus *Hosackia*.

Torrey and Gray (Flora of North America, 1838) used the name *Hosackia* for all the American species, as did Gray (Synopsis of the Species of Hosackia, 1863). Watson (Botany of California, 1876) followed Gray in recognizing the genus *Hosackia* and referred to it all the species belonging to the group under discussion. These three works, however, differ as to the number of sections and as to the

taxonomic position of certain species. Torrey and Gray (*op. cit.*, 1838), divided the group into four sections: *Euhosackia* Benth., *Drepanalobus* Nutt. (later in the same work changed to *Syrmatium* Vogel), *Microlotus* Benth., and *Psychopsis* Nutt. MSS. Gray (1863) grouped the species within the three sections, *Euhosackia*, *Microlotus*, and *Syrmatium*, and Watson (Botany of California) followed Gray in this usage. Gray and Watson reduced the five species of the section *Psychopsis* Nutt. as given in Torrey and Gray (*op. cit.*, 1838) to one species, *Hosackia purshiana* Benth., and assigned this species to the section *Microlotus*. The section *Microlotus* of *Hosackia* as given in Gray's Synopsis and in the Botany of California differs from Bentham's *Microlotus* of *Lotus* by the omission of a single species; this species, *Hosackia parviflora* Benth. (*Lotus micranthus* Benth.) having been assigned by Gray and Watson to the section *Euhosackia*. On the other hand, the section *Microlotus* in the Flora of North America contains not only *Hosackia parviflora* Benth. and *Hosackia subpinnata* T. & G. but also *Hosackia strigosa* Nutt. with its near relatives, and *Hosackia maritima* Nutt. Torrey and Gray believed that these latter species show a complete transition from the single-flowered species of *Microlotus* to the umbellate species of typical *Hosackia*.

In 1890 Greene remanded all the New World species to the genus *Lotus* under four sections corresponding to the following genera of earlier authors: *Acmispon* Raf., *Anisolotus* Bernh., *Hosackia* Benth., and *Syrmatium* Vogel. In Engler and Prantl (Die Natürlichen Pflanzenfamilien) all the American species are referred by Taubert to the genus *Hosackia*. On the other hand, some of the more recent authors have not only discarded the generic name *Lotus* for the New World species, but have treated the several groups (*Hosackia*, *Acmispon*, *Anisolotus*, and *Syrmatium*) as distinct genera. In general, each author's usage has differed from all other treatments in regard to the generic concept and also in regard to the limits ascribed to the species. The various assignments of the species to *Lotus* and its segregates may be summarized as follows:

1. All the American species have been referred to the Old World genus *Lotus*.

2. All the New World plants have been treated as a distinct genus under the name *Hosackia*.

3. The American species have not only been regarded as wholly distinct generically from the genus *Lotus* of the Old World, but have

been segregated into several genera: *Hosackia* Benth., *Acmispon* Raf., *Syrmatium* Vogel, and *Anisolotus* Bernh.

4. The genus *Hosackia* has been recognized as including the greater number of American species, while at the same time certain of the species were remanded to the Old World genus *Lotus*.

Reasons for Remanding the New World Species to the Old World Genus *Lotus*

While the North American species have been assigned to two or more distinct genera, the species which form the most well-marked group are those which have been referred to the genus *Syrmatium* (subgenus *Syrmatium* of this paper). In general they are characterized by small indehiscent arcuate legumes which with the persistent calyx and pedicel are deciduous at maturity. These characters, however, with the exception of the deciduous fruit, are not constant for all the species assigned to the group. The legumes of some may be tardily dehiscent, as has been observed in the case of *Lotus eriophorus* Greene (*Syrmatium eriophorum* Heller), while two of the species, *Lotus glaber* Greene (*Syrmatium glabrum* Vogel), and *Lotus leucophyllus* Greene (*Syrmatium sericeum* Greene), have straight or slightly falcate legumes. The leaves, inflorescence, and flowers possess only those characters which have their counterpart in many of the species of the groups *Hosackia* and *Acmispon*. The deciduous fruit is therefore the only distinguishing character which is constant for the *Syrmatium* group. Shall we recognize such a character as of sufficient importance to justify the formation of a new genus? Of this Greene (1890) says: "Since the jointed pedicels and deciduous fruiting calyces of for example the *Lagopus* subgenus of *Trifolium* are not to be of generic import, neither may they be so treated in this group of *Lotus* which has been called a genus under the name *Syrmatium*."

A consistent treatment of the remaining species would demand recognition of at least five generic groups: (1) *Hosackia* Benth. including those species with stipules, (2) *Acmispon* Raf. represented by *L. americanus* Bisch. with its three-foliolate leaves, (3) *Anisolotus* Bernh. embracing *L. subpinnatus* Lag., *L. humistratus* Greene, and *L. denticulatus* Greene, all having seeds and corollas that differ slightly from those of the other American species, and (4 and 5) two additional genera separated by characters of corolla and stigma.

If the Californian species were grouped according to the method outlined above they would segregate into five or six genera, largely on the basis of single characters which are of doubtful generic importance. The appearance of intergrades also presents an objection. For example, *Lotus oblongifolius* Greene var. *cupreus* of the subgenus *Hosackia*, with its short leaves of three to seven leaflets, its small flowers with petal claws approximate, and its few-flowered umbels (mostly 1 to 3), more closely resembles some of the species within the subgenus *Acmispon* than it does the other species of the subgenus *Hosackia*. *Lotus micranthus* Benth. is another of these troublesome species and has been disposed of in different ways by the various authors.

It has been suggested that the Old World genus *Lotus* is used in too restricted a sense and that it should be extended to include several other closely related genera. With reference to this point, Greene (1890) states: "*Lotus Tetragonolobus*, *Lotea*, *Krokeria* and *Dorycnium* of the Old World along with *Acmispon*, *Anisolotus*, *Hosackia*, and *Syrmatium* of the New World are even more naturally of one genus than are the various subdivisions of the one genus *Trifolium* as now everywhere received." If we accept the view that the New World species are not sufficiently diverse to be referred to different genera, but constitute a natural generic group, we have next to consider whether the American species are generically distinct from the Old World genus *Lotus*, as used in the broader sense indicated above, or whether they form merely a part of it.

As a result of careful study of the literature and of available plant material, we find that the American species as a group possess no constant characters of inflorescence, flower, or fruit which distinguish them generically from the European *Loti* as conceived by Greene. The most nearly constant character that has been used in separating the two groups relates to the leaves. The typical leaf in the Old World species is pinnately compound with three leaflets at the apex of the rachis and two at the base of the leaf, close to the stem, simulating stipules. The leaves of the New World species are far from uniform in the number and arrangement of the leaflets. They vary from pinnately to subpalmately compound with the leaflets ranging in number from three to fifteen or more. According to the usage adopted in the present paper distinct stipules are always present in the subgenus *Hosackia*, while in the subgenera *Acmispon* and *Syrmatium* the stipules are reduced to glands. The leaves of

three or four species of the subgenus *Acmispon* resemble very closely those of the typical European *Loti*. Leaves with three leaflets at the apex of the rachis and one at the base near the stem are of common occurrence in *Lotus subpinnatus* Lag. and in *L. humistratus* Greene, while in *L. americanus* Bisch. leaves with one terminal leaflet and two lateral ones near the stem are the rule. Moreover, certain Old World species which differ in leaf character from the *Lotus* type in the restricted sense possess leaves similar to those occurring in certain species of the American representation; for example, the short petioled subpalmate leaves with gland-like stipules of *Dorycnium suffruticosum* Villars correspond closely to those of *Lotus wrightii* Greene of the American species.

Therefore, since characters of generic importance are lacking in inflorescence, flower, and fruit, and since the distinctive leaf characters in addition to being merely vegetative are weakened by the presence of exceptions and intergrades, we have remanded the American species to the Old World genus *Lotus* in its broadest sense.

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SYSTEMATIC TREATMENT

Explanation of Certain Terms Used in the Text

Calyx tube should be interpreted to include the short hypanthium at the base of the flower. *Length of flower* refers to the distance between the tip of the wings and the apex of the pedicel. The terms *Lower Sonoran, Upper Sonoran,* and *Transition* refer to life zones in which the different species herein treated are found growing. In general, the *Lower Sonoran* extends from sea level to the foothills, the *Upper Sonoran* comprises the Foothill Belt, and the *Transition* covers the Yellow Pine Belt. Quotations followed by "Jepson '06, Kew Herb." signify that these quotations were taken from a manuscript volume of notes made by Dr. Jepson in 1906 while studying the types of *Lotus* and *Hosackia* at the Kew Herbarium.

LOTUS [Tourn.] L.

Annuals or perennials, the perennials herbaceous or suffrutescent. Leaves pinnately compound, rarely subpalmate; leaflets one to many, entire-margined; stipules foliaceous, membranous, scarious, or gland-like. Flowers in axillary umbels or rarely solitary, mostly leafy-bracteate. Calyx cylindrical, with teeth more or less subequal. Corolla whitish to yellow, tinged or streaked with red, rose, or purple; wings obovate or oblong, adhering at base to the gibbous keel by means of a lobe or process; keel incurved, beaked, or obtuse. Petals and diadelphous stamens attached to a short perigynous disk or hypanthium. Ovary one to many-ovuled; style incurved. Legumes straight to strongly arcuate.

Subgenus 1. Hosackia. Perennials; leaves odd-pinnate with foliaceous, membranous, or scarious stipules; flowers usually more than 1 cm. long, several to many in long-pedunculate umbels; legumes dehiscent, straight, abruptly short-beaked, several to many-seeded; fruit not reflexed.

Legumes linear-oblong, 3 or more mm. wide; bracts usually distant from the umbel and often pinnately compound; pedicels 1 mm. to 1 cm. long; claws of petals exserted beyond calyx tube; blades of the keel and banner shorter than their claws.

Densely gray-woolly; calyx teeth linear-subulate, 1.5 to 3 mm. long.....1. *L. incanus.*

Villous to glabrous; calyx teeth less than 2 mm. long.

Villous to glabrate, often glandular; leaflets oblong to oval (obovate), those of the variety glaucous on the under side; calxy teeth triangular or subulate; legumes 2 to 4 cm. long.....2. *L. stipularis.*

Mature herbage glabrous, young herbage densely covered with short arched hairs; leaflets oval, rhombic, or obovate, under side glaucous, with few short appressed hairs; calyx teeth short subulate-triangular (or longer); legumes 3.5 to 7 cm. long.....3. *L. crassifolius.*

Legumes linear; bracts, when present, mostly of 1 to 3 leaflets closely associated with the umbel; pedicels short, rarely over 1 mm. long.

Glabrous or nearly so; flowers 1.3 to 2 cm. long; claws of the petals distinctly exserted beyong the calyx tube, those of the keel longer than the narrowly beaked blade.

Bract absent as a rule; flowers yellow and white or cream-color.....4. *L. pinnatus.*

Bract of 1 to 3 leaflets; banner yellow, wings pale rose or lilac, tip of keel purple.....5. *L. formosissimus.*

Hirsute-pubescent to nearly glabrous; flowers 7 mm. to 1.5 cm. long; claws of the petals obscurely exserted beyong calyx tube, those of the keel only about one-half the length of the broad rounded blade.....6. *L. oblongifolius.*

Subgenus 2. Acmispon. Annuals or perennials; leaves pinnate or in a few species subpalmate, short (except in *L. grandiflorus*); stipules gland-like; flowers 4 mm. to 2.5 cm. long, solitary or umbellate, mostly peduncled; legumes dehiscent, straight or nearly so, abruptly short-beaked, two to many-seeded, not reflexed.

Stigma capitate with a collar of spreading hairs below it; wings conspicuously longer than the keel, canoe-shaped, one beneath, the other inverted over the keel; banner blade attenuate into the claw.

Perennials; umbels pedunculate, one to many-flowered.

Leaf rachis elongated; flowers 1.3 to 2.5 cm. long; umbels mostly several-flowered.....7. *L. grandiflorus.*

Rachis short, bearing few leaflets, leaves often subpalmate; umbels 1 to 3 (to 5)-flowered.

Plant erect; stems stiff, internodes long; leaves small; flowers 1.3 cm. to 2.2 cm. long; legumes typically straw-colored, terete, 2 to 5 cm. long by 3 to 5 mm. wide, many-seeded; seeds granulose.....8. *L. rigidus.*

Plants procumbent to ascending; internodes not conspicuously long; seeds not granulose but occasionally shallow-pitted.

Legumes mostly reddish brown, appressed-pubescent, 2.5 mm. or less wide; flowers 8 to 10 mm. long..9. *L. wrightii* var. *multicaulis.*

Legumes mostly straw-colored, thinly silky-pubescent, 1 to 2.2 cm. long, 2 to 4 mm. wide; flowers 8 to 12 mm. long.....10. *L. argyraeus.*

Annuals; umbels pedunculate, 1 to 3-flowered.

Seeds quadrate, granulose, sometimes rugose.....11. *L. strigosus.*

Seeds subglobose, granulose, sometimes rugose.....12. *L. tomentellus.*

Stigma capitate but without the collar of hairs; wings of about the same length as the keel, more or less strap-shaped, one on either side of the keel; banner blade abruptly clawed; flowers not over 1.2 cm. long; annuals.

Seeds orbicular to short-oblong, ends always rounded; legumes linear; flowers peduncled (except in variety of *L. americanus*).

Leaf rachis dilated; umbels 1 to 5-flowered; keel obtuse, not attenuately beaked.....13. *L. salsuginosus.*

Leaf rachis scarcely if at all dilated; umbels reduced to one flower; keel acute, attenuately beaked.

Calyx teeth shorter than the tube; legumes constricted between the seeds; leaves, at least many of them, of more than 3 leaflets. ....14. *L. micranthus*

Calyx teeth longer than the tube, approaching the length of the corolla; legumes scarcely if at all constricted between the seeds; leaves of 3 (1 to 5) leaflets....15. *L. americanus.*

Seeds variable but always flattened and angled at one or both ends, a cross-section through center diamond-shaped; legumes oblong to linear; flowers subsessile; rachis dilated.

Legumes 1 to 2.5 cm. long.

Plants erect; flowers whitish cream-color, tinged with purple; calyx teeth longer than tube....16. *L. denticulatus.*

Plants not erect; flowers yellow, tinged with reddish purple; calyx teeth shorter or slightly longer than the tube....17. *L. subpinnatus.*

Legumes not more than 1 cm. long; plant not erect; flowers yellow, tinged with reddish purple; calyx teeth much longer than the tube. ....18. *L. humistratus.*

Subgenus 3. Syrmatium. Mostly perennials (often flowering the first season); leaves short-pinnate with gland-like stipules; flowers 2 to 12 mm. long, umbellate (umbels sometimes reduced to a single flower); legumes small, less than 2 cm. in length, arcuate to nearly straight, mostly attenuate into a long incurved beak, one to several-seeded; fruits reflexed, indehiscent, deciduous at base of pedicel.

Annuals; legumes usually 2-seeded, more or less constricted between the seeds, long and slender, slightly curved.

Umbels pedunculate; flowers 5 to 7 mm. long; style glabrous....19. *L. nuttallianus.*

Umbels nearly sessile; flowers 3 to 4.5 mm. long; style pubescent....20. *L. hamatus.*

Perennials.

Legumes one to several-seeded, not constricted (slightly so in *L. benthamii*).

Claws of petals exserted beyond calyx tube (except in variety of *L. leucophyllus*); flowers in pedunculate or sessile umbels and more than 5 mm. long.

Umbels sessile or short-peduncled, ebracteate; calyx teeth erect.

Umbels 1 to 4-flowered; legumes straight or falcate; herbage appressed silky-canescent....21. *L. leucophyllus.*

Umbels many to few-flowered; legumes falcate; pubescence (except in var. *veatchii*) scanty, appressed, confined to young herbage and calyces and occasionally to legumes....22. *L. scoparius.*

Umbels peduncled; bract, when present, of 1 or 2 leaflets; legumes falcate.

Calyx teeth subulate, often recurved....23. *L. benthamii.*

Calyx teeth short subulate-triangular....22. *L. scoparius* var. *traskiae.*

Claws of petals not exserted beyond calyx tube; flowers mostly solitary and not over 6 mm. long....24. *L. haydonii.*

Legumes 1 or 2-seeded, arcuate, often short and fat.
Calyx teeth short-triangular; keel equal in length to the wings or longer; herbage glabrous or with appressed pubescence.....25. *L. junceus.*
Calyx teeth linear or subulate; keel equal in length to the wings or shorter; herbage pubescent.
Pubescence somewhat woolly, hairs of young stems loose and spreading making with the stem, at point of insertion, a right or an obtuse angle; legume abruptly beaked, not keeled or only slightly so.....26. *L. eriophorus.*
Pubescence mostly appressed, hairs of young stems always joining the stem at less than a right angle; legume attenuately beaked, mostly clearly keeled.
Banner blade oblong to short-oblong, making an acute angle with the wings.
Pubescence not silky, hairs on leaves and calyces somewhat arched.....27. *L. douglasii.*
Pubescence usually silky, hairs on leaves and calyces soft, straight, mostly long.....28. *L. argophyllus.*
Banner blade short-obovate, either reflexed, or erect and making a right angle with the wings.....29. *L. davidsonii.*

1. **L. incanus** Greene (pl. 61). Densely gray-woolly somewhat silky perennials, erect, 1.5 to 3 dm. tall; leaves 2 to 8 cm. long; leaflets 5 to 15, commonly 7 or 9; stipules ovate, scarious or membranous; umbels few to many-flowered, on peduncles slightly shorter than the leaves; bract typically stipulate, pinnately compound, closely associated with the umbel or removed from it; pedicels more than 1 mm. long; flowers 1.2 to 1.5 cm. long; calyx teeth linear-subulate, hairy, less than one-half the length of the oblong-campanulate tube; claws of the petals long and exserted beyond the calyx tube; banner claw removed from the other claws; wings longer than the short obtuse keel; legumes reddish or dark yellowish brown, with glabrous surface finely reticulated, 1.5 to 4 cm. long by 3 to 7 mm. wide; seeds several, suboval, smooth, mottled with olive and black, 3 mm. or less long.

Open places in pine woods of Butte, Placer, and Nevada counties. Of limited occurrence in Upper Sonoran and Transition. Distribution Map 1. May–July.

Localities.—Near Stirling, Butte County, *Heller* 10797; Stirling City; *Hall*, May 27, 1913; Alta, Placer County, *K. Brandegee*, July 6, 1889; Alta, *Kellogg* 37; Cape Horn, Placer County, *K. Brandegee;* Blue Cañon, Placer County, *Walker* 1278; near Gold Run, Placer County, *Sonne*, June 5, 1891.

References.—Lotus incanus Greene, Pitt., vol. 2, 1890, p. 147. *Hosackia incana* Torr., Pac. R.R. Rep., vol. 4, part 5, 1857, p. 79, pl. 4; type loc., dry hillsides near South Yuba, *Bigelow.*

2. **L. stipularis** Greene (pl. 62 and pl. 63, fig. 1). Taller than *L. incanus* Greene, its villous pubescence less dense and not at all silky, the hairs long and somewhat wavy; largest leaves 10 to 13 cm. long; leaflets 11 to 15 (19) in number, oval or almost oblong, often with first pair at the base of the leaf and more or less covering the stipules;

stipules auricled or not, broadly ovate to lanceolate, foliaceous or membranous; umbels 4 to 8-flowered; bract as for *L. incanus* Greene; flowers 1 to 1.2 cm. long on pedicels 2 to 4 mm. long, differing from those of the species mentioned above only in having short-triangular or subulate calyx teeth 1 (2) mm. or less long; corolla white veined with rose; legumes not more than 3 cm. long and between 2 and 3 mm. wide; seeds as for the preceding species.

In the form represented by Kellogg's *Hosackia balsamifera,* viscid-glandular hairs which exude a yellow resinous substance are scattered over herbage and fruit, and the entire plant is said to be remarkably fragrant.

Hillsides and mountain slopes of the Coast Ranges from Monterey County to Mendocino County, thence eastward through Shasta and Butte counties to Amador County, and south into Mariposa and Tulare counties. Less frequent in the Sierra Nevada than in the Coast Ranges. Distribution Map 1. April–July.

Localities.—Pacific Grove, *Elmer* 4599; Big Basin, Santa Cruz County, *Eastwood* in 1916; Loma Prieta, Price, June 17, 1890; Loma Prieta, *Elmer* 4449; Kings Mountain, San Mateo County, *C. Baker* 805; Kings Mountain, *Abrams* 2460; Redwood Peak, *Ottley* 1245 (slightly glandular); Redwood Peak, Oakland, *Drew,* July 1, 1889, "pubescence the same as in the type of *Hosackia stipularis* Benth. The specimen does not differ from the type essentially, save in its stipules which are too small and scarcely auricled enough." Jepson '06, Kew Herb.; type of *Hosackia balsamifera* Kellogg, no locality given (Calif. Acad. Sci. Herb.); San Rafael, Marin County, *Rattan;* Lagunitas, *Eastwood* 63; Hood's Peak, Sonoma County, *Bioletti,* June 7, 1893 (glandular); Cobb Mountain, Lake County, *Leighthold,* July, 1893 (glandular); Ukiah, *Blasdale* 1005; Mendocino, *Kellogg* 40 (glandular); Squaw Creek Ranger Station, Shasta County, *Drew* in 1916 (glandular); De Sabla, Butte County, *Edwards* in 1917 (glandular); Ione, Amador County, *K. Brandegee;* Green Gulch, Mariposa County, *Congdon,* April, 1893 (form with narrow leaflets); Agua Fria, Mariposa County, *Congdon,* April 17 and May 27, 1894; 46 Maple Cañon, Colony Road, Kaweah River basin, *Hopping,* May 27, 1901; Cedar Creek, Sequoia Park, *Jepson* 596 (pods narrow, glandular); Watson Spring, Sequoia Park, *Jepson* 584 (glandular).

Var. **subglaber** Ottley n. nom. (pl. 63, figs. 2–8). Prostrate to erect; nearly glabrous; underside of leaflets glaucous, with scattered hairs usually shorter than for the species; pedicels 1 to 2 mm. long; calyx turbinate, with ciliolate triangular teeth; corolla white deeply suffused with rose; legumes 1.5 to 4 cm. long, 3 to 4.5 mm. wide.

Borders of woods of the plains, hills, or mountains of Sonoma, Mendocino, Humboldt, and Del Norte counties, from sea level into the Transition. Extends north into Washington. Distribution Map 1. April–July. Undoubtedly the type plant described by Eastwood as *Hosackia rosea* is a small low much branched form of this variety. Other plants labelled "*Hosackia rosea*" by Eastwood (Eastwood 105 and 1686) are larger than the type and resemble some of the Tracy sheets cited below which represent the natural type more nearly than does the artificial type, i.e., the Eastwood original specimen.

Localities.—Near Adams Station, Del Norte County, *Eastwood* 105; near Little Bear Harbor, *Bolander* 6510; Redwood Creek, Humboldt County, *Jepson* 1944; Bald Mountain, 4000 ft. alt., *Tracy* 4599, 4576; Bald Mountain, *Davy* and *Blasdale* 5618; Arcata, *Chesnut* and *Drew*, July 8, 1888; Eureka, Humboldt County, *Blasdale*, May 31, 1896; immediate vicinity of Eureka, *Tracy* 1078, 2389, 2390, 2462; near Kneeland Prairie, *Rattan*, June, 1883; Kneeland Prairie, *Tracy* 2485, 3073; Fort Bragg to Glen Blair, Mendocino County, Eastwood in 1894 (type of *Hosackia rosea* Eastw.); Fort Bragg to Glen Blair, *Eastwood* 1686; Fort Bragg to Glen Blair, *Ottley* 1501 (erect), 1512 (prostrate to ascending, noticeably pubescent); Fort Bragg, *W. C. Mathews* 50; plains of Mendocino, *State Survey* 4717, 4789; Gualala, Sonoma County, *Michener* and *Bioletti*, July 6, 1892 (difficult to tell whether this plant is *L. stipularis* Greene or the variety *subglaber*); Forest Hill, *Bolander* 4617. Oregon: Mt. Emily, *Jepson*, 9375. Washington: Mason County, *Piper* 1044.

References.—LOTUS STIPULARIS Greene, Pitt., vol. 2, 1890, p. 147. *Hosackia stipularis* Benth., Trans. Linn Soc., vol. 17, 1837, p. 365, type from California, *Douglas*. *Hosackia macrophylla* Kellogg, Proc. Calif. Acad., vol. 2, 1861, p. 123. *H. balsamifera* Kellogg, *loc. cit.*, p. 125, fig. 40; type loc., summits back of Oakland according to Jepson, Fl. W. Mid. Calif., ed. 1, 1901, p. 300. *Lotus balsamiferus* Greene, Man. Bay Reg., 1894, p. 93, "Hood's Peak, Sonoma County, *Bioletti*. Doubtless a rediscovery of Dr. Kellogg's *Hosackia balsamifera*." Var. SUBGLABER Ottley. *Hosackia rosea* Eastw., Proc. Calif. Acad., ser. 2, vol. 6, 1896, p. 424, pl. 55; type loc., along road to Glen Blair near Fort Bragg.

3. **L. crassifolius** Greene (pls. 64 and 65). Tall erect perennials (sometimes attaining a height of 12 dm.); bright green, glabrate, the young herbage with densely matted short arched hairs; stem broad and fistulose; leaves long; leaflets 7 to 15 (rarely all opposite), oval, rhombic, or obovate; stipules scarious, narrowly or broadly ovate; umbels many-flowered, peduncles shorter than the leaves; bract as for *L. stipularis* Greene; pedicels varying in length from more than 1 mm. to almost 1 cm.; flowers 1 to 1.5 cm. long; calyx teeth usually very short and subulate-triangular, although occasionally as long as in *L. stipularis;* corolla greenish yellow marked with dark red; legumes 3.5 cm. to 7 cm. long by 3 mm. or more wide—larger than for any other species of the Californian *Loti*.

Foothills and mountains from San Jacinto Mountains north to the Columbia River. Frequent, often forming a thick rank growth in the Upper Sonoran and Transition, extending in its southern range to an altitude of 8000 feet. Distribution Map 1. May–July.

Localities.—Sisson, *Jepson*, July–August, 1894; Quartz Valley, Siskiyou County, *Butler* 1452; between Shasta Retreat and Shasta Springs, *Heller* 7972; Gasguets to Waldo, Del Norte County, *Dudley* in 1899; Klamath River, Humboldt County, *Chandler* 1470; Potter Valley, Mendocino County, *Purpus*, April, 1898; near Newville-Covelo road, Glenn County, *Heller* 11995 (calyx teeth long, subulate); divide between Lakeport and Hopedale, Lake County, *C. Baker* 3001;

Butts Cañon, Lake County, *K. Brandegee;* foothills south of Mt. Sanhedrin, Lake County, *Heller* 5857, 5933; Kelseyville to Cloverdale, *T. S. Brandegee,* July, 1885; Collins Camp, Vaca Mountains, *Jepson,* August 17, 1892; Mt. Diablo, *Bioletti,* May 13, 1894; above Alma Soda Springs near "French Settlement," Santa Clara County, *Heller* 7489; Black Mountain, Santa Clara County, *Elmer* 4695; Mt. Hamilton, *Pendleton* 881; near Big Spring, Santa Lucia Mountains, *Hall* 10008; divide between Fish and Monrovia cañons, San Gabriel Mountains, *Ottley* 622; Mt. Baldy, 7000 ft. alt., San Antonio Mountains, *Johnston* 1495; Palomar, *Jepson* 1490; Palomar, *T. S. Brandegee,* August 1, 1898; San Jacinto Mountains, *Anthony,* July 13, 1895; Santa Ana Cañon, San Bernardino Mountains, *R. Smith* 15B; San Bernardino Mountains, *Parish,* June, 1892; Bear Valley, San Bernardino Mountains, *Parish Bros.* 399; Tehachapi Mountains, *Hasse* and *Davidson* 1683; South Fork, Kaweah River, Tulare County, *Culbertson* 4293; 48 Maple Cañon, Colony Road, Kaweah River basin, *Hopping,* May 27, 1901; Giant Forest (6500 ft. alt.), *Jepson,* June 24–July 2, 1900; Old Colony Mill, Sequoia Park, *Jepson,* 627; Old Colony Mill, *K. Brandegee,* July 26, 1905; south of Pinehurst, *Ottley* 1373; Bubbs Creek, *Ottley* 1472; Pine Ridge, Fresno County, *Hall* and *Chandler* 163; Crocker's, Yosemite National Park, *Eastwood* 30; Rosasco's Meadow, Tuolumne County, *Chesnut* and *Drew,* June 24, 1889; Hetch-Hetchy, *Jepson* 3421; lower end of Donner Lake, *Heller* 7150 (one fruit in an umbel); Placer County, *Carpenter,* August–October, 1892; Humboldt road north of Chico, Butte County, *Austin* 390; Mill Creek, Plumas County, *Austin,* July, 1876; Susanville, *T. S. Brandegee,* July 1, 1892; Modoc County, *M. S. Baker,* July 19, 1893; timbered hills, McCloud River, Siskiyou County, *M. S. Baker,* August 18, 1893; Goose Valley, Shasta County, *Eastwood* 823 (slightly pubescent, some of the calyx teeth long). Oregon: prairies, Hood River, *Henderson,* July 15, 1896 (in part).

References.—Lotus crassifolius Greene, Pitt., vol. 2, 1890, p. 147. *Hosackia crassifolia* Benth., Trans. Linn. Soc., vol. 17, 1837, p. 365, type from California, *Douglas. H. stolonifera* Lindl., Bot. Reg., vol. 23, 1837, t. 1977, type from California, *Douglas. H. stolonifera* Lindl. var. *pubescens* Torr. *in* Pac. R.R. Rep., vol. 4, part 5, 1857, p. 79, type loc., Corte Madera, *Bigelow. H. platycarpa* Nutt. *in* T. & G. Fl., vol. 1, 1838, p. 323.

4. **L. pinnatus** Hook. (pl. 66, figs. 1–6). Essentially glabrous plants, 2 to 4 dm. tall, with stems ascending from a thickened perennial root; stems with little woody tissue and delicate, indicative of the damp habitat; leaves 4 to 7 cm. long, shorter than the peduncles; leaflets 5 to 9, oval or obovate, obtuse or acute, somewhat mucronulate; stipules narrowly ovate, 3 to 5 mm. long; umbels 3 to 7-flowered, mostly bractless, with only the involucre of scarious bractlets; flowers 1.2 to 1.5 cm. long, slightly reflexed, on pedicels less than 1.5 mm. long; calyx tube 6 to 7 mm. long, the conic hypanthium darker than the thin transparent cylindrical calyx tube, calyx bilabiate, the two upper teeth short-triangular, the other three long-subulate; banner and keel yellow, wings white with no trace of purple (according to all descriptions); claws of petals long-exserted as in the three preceding species, banner

more reflexed, wings obovate, keel beaked and subacute; legumes 4 to 6 cm. long and 1.5 mm. wide; seeds many, oblong (according to Howell, Flora of Northwest America, 1903, p. 140).

Of only occasional occurrence along streams or in springy places, in Trinity and Shasta counties and in the northern Sierra Nevada from Plumas County to Calaveras County. More abundant north of the state. According to W. J. Hooker, Douglas found this plant growing abundantly in low alluvial overflowed soils between Fort Vancouver and Grand Rapids upon the Columbia, and also near the base of Mt. St. Helen's. Distribution Map 2. April–July.

Localities.—Washington: Yakima region, *T. S. Brandegee* 33; Tacoma, *Fleet,* June 7, 1894. Idaho: Cottonwood, Idaho County, *Henderson*, June 27, 1894; Palouse country and about Lake Couer d'Alene, *Aiton* in 1892; Latah County, *Sandberg*, 402 (foliaceous bract present in some of the umbels); Kootenai County, *Leiberg* 615, "corresponds well with type of *Lotus pinnatus* Hook.," Jepson '06, Kew Herb. California: Indian Valley, Plumas County, *Austin* in 1876; five miles northwest of Greenville, *Stephens*, April 29, 1894; Quincy, Plumas County, *Jepson* 4141; Donner Lake, *Sonne*, July, 1888, in part (U.C. Herb.); Emigrant Gap, Placer County, *Jones* 3282; Placer County, *Hardy* in 1893, in part (U.C. Herb.), resembles *L. formosissimus* Greene in general aspect but does not have a bracteate inflorescence; El Dorado County, *Gross* in 1903 (umbels ebracteate or with a bract of 3 leaflets); Poole's Meadow, Calaveras County, *Davy* 1435; De Sabla, Butte County, *Edwards* in 1917; near Redding, *Heller* 7905; Squaw Creek Ranger Station, Shasta County, *Drew* in 1916; Montgomery Creek, Shasta County, *Eastwood* 645; northeast of Weaverville, Trinity County, *Yates* 344 (bract of 1 small leaflet in some of the umbels); foot of Mt. Sanhedrin, Lake County, *Reynolds,* June, 1917.

References.—Lotus pinnatus Hook., Bot Mag., vol. 56, 1829, t. 2913, type from northwestern North America, *Douglas*. *Hosackia bicolor* Dougl., Bentham *in* Lindl. Bot. Reg., vol. 15, 1829, t. 1257, type from northwestern North America, *Douglas*. *Lotus bicolor* Frye & Rigg, Fl. Northwest, 1912, p. 234; Frye & Rigg, Elem. Fl. Northwest, 1914, p. 140.

5. **L. formosissimus** Greene (pl. 66, figs. 7–13). In general aspect resembling a small decumbent form of *L. pinnatus* Hook., but differing from it in having a bract of 1 to 3 (to 7) leaflets; leaflets of lower leaves obovate, obtuse; stipules ovate, sometimes attaining 1.5 cm. in length; no marked contrast between hypanthium and calyx tube; calyx but slightly bilabiate, the two dorsal teeth more than one-half the length of the other three; wings of corolla spreading, faint lilac or rose becoming darker upon drying; tip of keel purple; seeds small, varying from oblong to asymmetrically oval.

Moist situations in the coastal counties, extending north from Monterey and San Benito counties into Oregon and Washington. Sonoran. Distribution Map 2. March–June.

Localities.—San Benito County, *Eastwood* in 1915; Carmel, *Ottley* 1310; Pacific Grove, *Elmer* 3548; Pacific Grove, *Heller* 6669; Pescadero Ranch, Monterey County, *Brewer* 655; Pescadero, *Hutchings*,

April 4, 1895; Moss Beach at Halfmoon Bay, *K. Brandegee*, June, 1905; Crystal Springs Lake, San Mateo County, *C. Baker* 689; Lake San Andreas, San Mateo County, *Davy* 1030; San Bruno Hills, *Ottley* 267; Corte Madera, *Greene*, April 16, 1882; Olema, Marin County, *Blasdale*, April 13, 1895; Marin County, *Michener* and *Bioletti* 66A; Bodega Bay, *Chandler* 674; near Windsor, Sonoma County, *Heller* and *Brown* 5332; Valley Ford, Sonoma County, *Lobenstein* in 1906; Kenwood, Sonoma County, *Michener* and *Bioletti*, June, 1893; Lower Lake, Anderson Ranch, Lake County, *Bowman* in 1901; Mendocino County, *Bolander* 4725; near Fort Bragg, Mendocino County, *Davy* 6559, "a very good match for type of *Hosackia gracilis* Benth., collected by Douglas, doubtless at Monterey, differing only in the smaller stipules, type stipules 4 to 7 mm. long." Jepson '06, Kew Herb.; Humboldt Bay, *Chandler* 1200; Kneeland Prairie, Humboldt County, *Chesnut* and *Drew*, July 8, 1888; near Campbell, Humboldt County, *Chesnut* and *Drew*, July 8, 1888; Eureka to Arcata, *Jepson* 1922; Requa, Del Norte County, *Davy* and *Blasdale* 5903; Lake Earle, Del Norte County, *Davy*, June, 1902. Washington: near Montesano, Chehalis County, *Heller* and *Heller*, 3934. Oregon: Curry County, *Thompson* 204.

References.—Lotus formosissimus Greene, Pitt., vol. 2, 1890, p. 147. *Hosackia gracilis* Benth., Trans. Linn. Soc., vol. 17, 1837, p. 365, type from California, *Douglas.*

6. **L. oblongifolius** Greene. Stems bright green, 1.5 to 3 dm. high, arising from a slender rootstock; herbage appressed-pubescent; leaflets linear-lanceolate or elliptical, acute at both ends; umbels 1 to 5-flowered, borne on peduncles exceeding the leaves; bract of 1 to 3 leaflets; flowers 8 mm. to 1.5 cm. long; calyx tube short-turbinate, somewhat villous; banner yellow more or less veined with purple; claws of petals scarcely exserted beyond calyx tube, the broad obtuse blade of keel longer than the claws.

Common in damp or wet situations in the foothills and mountains of southern California, passing into the variety *torreyi* in the southern Sierra Nevada. Distribution Map 2. May–October. The plants with the narrowest leaflets and the fewest flowered umbels are evidently the same as *Hosackia lathyroides* Dur. and Hilg. They doubtless represent only the first season's growth and have not yet developed a perennial rootstock, as for example, Abrams' 1879 from the San Gabriel River and Vought's specimen from the head of San Joaquin Valley. Elmer's 3975 from Mt. Pinos possesses a very short rhizome, otherwise closely resembling the collections cited above.

Localities.—Ojai and vicinity, Santa Clara Valley, *Peckham*, May 3, 1866; Oak Cañon Spring, Tehachapi Mountains, *Dudley* 407; Kernville, *T. S. Brandegee*, May 13, 1890; Witcher Cabin meadow, Mono County, *Kennedy*, August, 1916; head of San Joaquin Valley, *Vought*, May, 1896 (flowering the first season); near Manzana, Antelope Valley, *Davy* 2457; Antelope Valley, *Davidson*, May, 1895; Middle Creek, Mt. Pinos, Ventura County, *Hall* 6645; Mt. Pinos, *Elmer* 3975; Arroyo Seco, Los Angeles County, *Ottley* 682; Arroyo Seco, *Geo. B. Grant* 6293; near Los Angeles, *Davidson*, May, 1892; Los Angeles, *Davidson* in 1891 (flowering the first season); Rivera, Los Angeles

County, *Braunton* 329; Claremont, Los Angeles County, *C. Baker* 5059; West Fork of San Gabriel River, *Abrams* 1879 (no rootstock, apparently flowering the first season); Swartout Cañon, San Antonio Mountains, *Hall* 285; Lytle Creek Cañon, *Abrams* 2628; San Bernardino Valley, *Parish* 7151; Little Bear Valley, San Bernardino Mountains, *Wilder* 347; Seven Oaks Camp, San Bernardino Mountains, *Geo. B. Grant,* June 11–14, 1901; Fish Creek, San Bernardino Mountains, *Grinnell* 10; Santa Ana River, San Bernardino County, *Parish Bros.,* June, 1887; Victorville, *Jepson* 5606; Victorville, *Parish* 10579; vicinity of Strawberry Valley, San Jacinto Mountains, *Hall* 2380; Strawberry Valley, San Jacinto Mountains, *Jepson* 2258A; Los Coyotes, *Hall* 2832; Noble Ranch, between Pine Valley and Laguna, San Diego County, *Mearns* 3969; Laguna Mountains, San Diego County, *T. S. Brandegee,* June 20, 1904; Cuyamaca, *T. S. Brandegee,* July 6, 1894; Aliso Cañon, southern California, *Barber* 193; Palomar, *T. S. Brandegee,* August 1, 1898; San Diego, *Palmer* 61.

Var. **torreyi** Ottley n. comb. (pl. 67). Hirsute-pubescent becoming glabrate; leaflets oblanceolate or obovate, usually obtuse, those of the uppermost leaves often elliptical or oval and acute at both ends; flowers 1 to 1.5 cm. long. Although of the same general appearance as *L. pinnatus* Hook. easily distinguishable from that species by the hirsute pubescence, the short-turbinate calyx tube, the petal claws only obscurely exserted beyond the calyx tube, and the broad obtuse keel.

Common in damp or wet situations of the north Coast Ranges and in the Sierra Nevada from Modoc County south to Kern County. Transition. Distribution Map 2. May–September.

Localities.—Howell Mountain, *Jepson,* June 26, 1893; near summit of Mt. Sanhedrin, Lake County, *Heller* 6002; Ten Mile River, Mendocino County, *Eastwood,* June, 1894; coastal plain, Fort Bragg, *Ottley* 1541; Big Horse Mountain, South Fork, Eel River, *Jepson,* July–August, 1892; Bald Mountain, Humboldt County, *Tracy* 4527; Burr Valley on northwest slope of Buck Mountain, *Tracy* 3902; Coffee Creek, Salmon Mountains, Trinity County, *Hall* 8526; Swift Creek, Salmon Mountains, *Hall* 8682; McCloud River, Shasta County, *Hall* and *Babcock* 4120; Shasta Springs, *Geo. B. Grant,* September 15, 1902; Mt. Shasta, *Geo. B. Grant* 5236; West Fork, Woolly Creek, Siskiyou County, *Butler* 395; Etna Creek, Siskiyou County, *Butler* 397; Modoc County, *M. S. Baker,* in 1893; near Eagle Lake, Lassen County, *Baker* and *Nutting,* July 21, 1894; near mouth of Little Grizzly Creek below Genessee, Plumas County, *Heller* and *Kennedy* 8854; near Morgan, Tehama County, *Hall* and *Babcock* 4345; Brush Creek, Butte County, *Conger* in 1907; near Chicago Park, Nevada County, *Hall* 10211; Donner Lake, *Sonne* 62; lower end of Donner Lake, *Heller* 6882; Blue Cañon, Placer County, *Walker* 1289; Bear Valley, Placer County, *Jepson,* July, 1898; near Placerville, *K. Brandegee,* May 25, 1907; Gilmores, Tallac, El Dorado County, *C. J. Fox, Jr.,* July, 1895; Fallen Leaf, El Dorado County, *Ottley* 871, 1213; west of Woodfords, Alpine County, *Ottley* 1140; Panther Creek, Amador County, *Hansen* 1082; Pine Grove, Amador County, *Hansen* 348; Yosemite Valley and mountains, *Torrey* in 1865; Clarks and in Yosemite Valley, *Gray* in 1872; Yosemite Valley, *Bioletti* in

1900; Yosemite Valley, *Jepson* 3135; Crocker's, Mariposa County, *Blasdale*, May 21, 1896, "slightly less hairy than Gray's type of *Hosackia torreyi*." Jepson '06, Kew Herb.; Pine Ridge, Fresno County, *Hall* and *Chandler* 89, "slightly more hairy than the plant collected by Gray between Clarks and Yosemite Valley and cited as one of his types of *Hosackia torreyi*." Jepson '06, Kew Herb.; Bearskin Meadow, *Ottley* 1465; Round Meadow, Giant Forest, *Jepson* 676; North Fork, Kaweah River, Dougherty Meadow, *Dudley* 1431; Marble Fork, Kaweah River, Giant Forest, *K. Brandegee*, July 27, 1905; Three Rivers, Tulare County, *K. Brandegee* in 1905; South Fork, Kaweah River, Tulare County, *Culbertson* 4473; near Brown Meadow, southeastern Tulare County, *Hall* and *Babcock* 5156; Bishop Creek, Inyo County, *Shockley* 415; Little Kern River, *Jepson* 4907. The following plants, though lying within the range of the species, resemble the variety *torreyi* more than they do the species: Swanton, Santa Cruz County, *Rich* in 1912; Fall Creek, San Bernardino Mountains, *Crawford* 907 (8000 ft. alt.). Lower California: Nachoguero Valley, *Mearns* 3379.

Var. **cupreus** Ottley n. comb. Low much-branched flaccid perennials, with a closely branched woody underground stem; essentially glabrous; leaflets oblanceolate, mucronate, those of the lower leaves mostly cuneate-obovate; umbels 1 to 3-flowered; flowers 7 to 8 mm. long.

Meadows of the southern Sierra Nevada at 8000 ft. altitude or higher. Local. Distribution Map 2. June–August.

Localities.—North line of Sequoia Park, 8000 ft. alt., *Jepson* 738; open pine woods near Sand Meadow, Sequoia Park, *Jepson* 4672 (2 dm. high, a transition form between the species and the variety); in woods of Dougherty Meadow, North Fork, Kaweah River, *Dudley* 1427; meadow at head of Belknap Creek, Tulare County, *Hall* and *Hall* 8367; Hockett Meadow, 8500 ft. alt., Tulare County, *Hall* and *Babcock* 5588; Cahoon Meadow, Tulare County, 9000 ft. alt., *Dudley* 1811 (between the species and the variety); Owens Lake, Inyo County, 3600 ft. alt., *Hall* and *Chandler* 7327 (approaches habit of the species; leaflets linear-lanceolate).

References.—Lotus oblongifolius Greene, Pitt., vol. 2, 1890, p. 146. *Hosackia oblongifolia* Benth., Pl. Hartw., 1848, p. 305, type loc., "vicinity of Monterey," *Coulter* (locality doubtless erroneous). *H. lathyroides* Dur. and Hilg., Jour. Acad. Phila., ser. 2, vol. 3, 1854, p. 38, type loc., Fort Miller on the banks of the San Joaquin River, *Heermann*. *H. lathyroides* Dur. and Hilg., Pac. R.R. Rep., vol. 5, part 3, 1855, p. 6, pl. 3. *Lotus lathyroides* Greene, *loc. cit.* *Hosackia oblongifolia* var. *angustifolia* Wats., Bot. Calif., vol. 1, 1876, p. 135. Var. torreyi Ottley. *Hosackia torreyi* Gray, Proc. Am. Acad., vol. 8, 1873, p. 625, type specimens from Clarks to Yosemite Valley. *Lotus torreyi* Greene, *loc cit.* *Hosackia torreyi* var. *nevadensis* Gray, *loc. cit.*, type loc. near Donner Lake, *Torrey*. Var. cupreus Ottley. *Lotus cupreus* Greene, Leaflets Bot. Obs., vol. 1, 1904, p. 74, type loc., Hockett's Meadows, at 8600 feet altitude, *Baker*. *Hosackia cuprea* Smiley, Univ. Calif., Publ. Bot., vol. 9, 1921, p. 257.

7. **L. grandiflorus** Greene (pl. 68, fig. 1). Erect perennials, 4 to 7 dm. high, woody at base; leaves and young stems slightly puberulent, calyces more obviously so; leaves 3 to 9 cm. long; leaflets 7 to 9, obovate, obtuse, mucronate, the largest 4 cm. long by 1.8 cm. wide; stipules gland-like; umbels mostly few-flowered; peduncles exceeding the leaves; bract large, of 1 (to 3) leaflets; flowers a clear lemon-yellow, turning a deep rose with age, 1.7 to 2 cm. long, the calyx not quite half as long; calyx teeth varying from long-subulate with a broad base to nearly linear, half to nearly as long as tube, with soft short white hairs at the sinuses between the teeth; banner obovate-oblong, with blade rolling back, attenuate into the claw; wings much longer than the keel, more or less canoe-shaped, turned somewhat obliquely, one standing under, the other inverted over the keel; legumes linear, many-seeded.

Dry slopes in the Coast Ranges and in the Sierra Nevada from Shasta County to Mariposa County. March–July. The plants of the Sierra Nevada represent an extreme form which was named *Hosackia macrantha* by Greene. In this large form the leaves, peduncles, flowers, and fruit (legumes 2 to 7 cm. long, 3 to 5 mm. wide) always approach the upper limit in size. The triangular base of the long-subulate calyx teeth is more pronounced and the soft hairs at the sinuses between the calyx teeth are more abundant than in the plants of the Coast Ranges. The typical form occurs in the Coast Ranges but is not so abundant there as is the variety *mutabilis*. Distribution Map 3. *L. grandiflorus* Greene with *L. rigidus* Greene, *L. wrightii* Greene, *L. argyraeus* Greene, *L. strigosus* Greene, and *L. tomentellus* Greene form a group of species characterized by a corolla-form (see description above) unlike that of any other species of *Loti* found in California. Plates 68, 69, 70, 71.

Localities.—Santa Ynez Mountains, Santa Barbara, *Elmer* 3918 (Jepson '06, Kew Herb., says of a duplicate, "A most excellent match for the type of *Hosackia grandiflora* Benth."); Montgomery Creek, Shasta County, *Eastwood* in 1912; Brush Creek, Butte County, *Conger* in 1907; western Nevada County, *Essig* and *Hall* 10169; Magra Station, Placer County, *K. Brandegee*, June 5, 1908; Sweetwater Creek, El Dorado County, *Curran* in 1883 (type of *Hosackia macrantha* Greene); Agua Fria, Mariposa County, *Congdon*, May, 1884; Mariposa, *Congdon*, May 27, 1893. The plants cited below combine characters of the species and of the variety *mutabilis*. These plants are in general more robust than the variety but more pubescent than the species. Ridge above Collin's Camp, Vaca Mountains, Solano County, *Jepson*, June 12, 1893; Painted Cave Ranch, Santa Barbara, *Eastwood* 34; mountains near Santa Barbara, *State Survey* 291, March, 1861; Santa Monica Cañon, Los Angeles County, *Barber* 107, 107A, the latter specimen, according to Jepson '06, Kew Herb., "is conspecific with the type of *Hosackia grandiflora* var. *anthylloides* Gray"; Mountain Home Cañon, San Bernardino Mountains, *Hall* 7503; Glen Martain, San Bernardino Mountains, *Smith* 12; Mohave River district, *Palmer* 82; Strawberry Valley, San Jacinto Mountains, *Jepson* 1286; San Jacinto, *Gregory* in 1892.

Var. **mutabilis** Ottley n. nom. (pl. 68, figs. 2–6 and pl. 69, fig. 1). Shorter than the species, less than 3 dm. in height, with many aerial stems arising from a freely branching slender rootstock which ramifies in all directions; herbage velvety-pubescent, stems occasionally appearing frosted; leaves usually under 4 cm. in length; peduncles shorter or slightly longer than the leaves; flowers 1.5 to 1.8 cm. long; calyx villous; calyx teeth variable, long-subulate with broad base, or short subulate-triangular to linear, equal in length to the tube or slightly shorter; legumes 2 to 3.5 cm. long. Fairly common in the Coast Ranges, also present in the Sierra Nevada within Calaveras County. April–June.

Localities.—Mendocino County, *Bolander* 4752, May 10, 1866; near Fort Bragg, Mendocino County, *Davy* 6561; Mendocino Plains, *McMurphy* 139; Hough's Springs, Lake County, *Cleveland* 42; Vaca Mountains back of Miller Cañon, *Jepson*, May 23, 1897; ridge above Collin's Camp, Vaca Mountains, *Jepson*, August, 1892; summit of Yolo Mountains, *C. Baker* 2993; Mt. Tamalpais, *T. S. Brandegee*, June 13, 1892; Carmelo Valley, *Brewer* 675; Valley of Arroyo Seco, Monterey County, *Brewer* 677 (U.C. Herb.) "Brewer's 677 is nearer Gray's type of *Hosackia grandiflora* var. *anthylloides* than anything here in the Kew Herb." Jepson '06, Kew Herb.; Big Cholame Valley, on clay banks, Monterey County, *Hall* 10023 (leaves more than 4 cm. long); Santa Cruz Island, *T. S. Brandegee*, April, 1888; Paso Robles, San Luis Obispo County, *Barber*, April 23, 1899; Santa Clara Valley, *Peckham*, May, 1866; vicinity of Elizabeth Lake, *Hall* 3085; trail to Luken Peak, San Gabriel Mountains, *Ottley* 683; Lancaster, *K. Brandegee*, May, 1889; San Diego County, *Alderson* 1893; Cuyamaca, *T. S. Brandegee*, June 3, 1896, and June 3, 1906; San Jacinto Mountain, San Diego County, *Parish Bros.* 475; Cajon Pass, *Hall* 6224; Manzana, Calaveras County, *Sprague* 2456. The following (*L. confinis* Greene) are forms with flowers 1.8 to 2.2 cm. long, deep red even in bud (according to Greene); calyx teeth subulate, half the length of the tube: Witch Creek, *Alderson*, November, 1893; grade near Descanso, San Diego County, *T. S. Brandegee*, May 24, 1906.

References.—Lotus grandiflorus Greene, Pitt., vol. 2, 1890, p. 145 (not of Form.). *Hosackia grandiflora* Benth., Trans. Linn. Soc., vol. 17, 1837, p. 366, type from California, *Douglas*. *Anisolotus grandiflorus* Heller, Muhl., vol. 8, 1912, p. 20. *Hosackia macrantha* Greene, Bull. Calif. Acad., vol. 1, 1885, p. 81, type loc., Sweetwater Creek, El Dorado County, *Curran*. *Lotus macranthus* Greene, *loc. cit.*, p. 146. *Anisolotus macranthus* Heller, Muhl., vol. 8, 1912, p. 48. *Hosackia ochroleuca* Nutt. *in* T. and G. Fl., vol. 1, 1838, p. 323, type loc. near Santa Barbara. *Lotus guadalupensis* Greene, *loc. cit.*, p. 144, type loc., Guadalupe Island. *Hosackia? occulta* Greene, Bull. Calif. Acad., vol. 2, 1887, p. 394, type loc., Santa Cruz Island, "probably *Hosackia grandiflora* Benth.," *T. S. Brandegee*, Zoe, vol. 1, 1890, p. 134. Var. mutabilis Ottley. *Hosackia grandiflora* var. *?anthylloides* Gray, Proc. Acad. Phila., vol. 15, 1863, p. 350, type loc., Santa Lucia Mountains, *Brewer*. *Lotus leucophaeus* Greene, Pitt., vol. 2, 1890, p. 145. *Anisolotus leucophaeus* Heller, Muhl., vol. 8, 1912, p. 48. *Lotus confinis* Greene, Erythea, vol. 1, 1893, p. 258, type loc. in the mountains of San Diego County, near the boundary between the United States and Mexico, *Alderson*.

8. **L. rigidus** Greene (pl. 69, figs. 2–8). Erect from a woody, perennial taproot; branches long, coarse, and stiff, with long internodes and few small leaves; pubescence scanty, of short, white, appressed hairs, the old stem and leaves becoming glabrate, the calyces with less appressed and more abundant pubescence; stipules gland-like; leaflets 3 to 5 (when 5, leaves clearly pinnate), linear-oblong, obtuse at apex, often cuneate at base, variable in length; umbels 2 to 3-flowered; peduncles long, sometimes as much as 12 cm.; bract when present commonly of one small leaflet; flowers 1.3 to 2.5 cm. long, in general appearance like those of *L. grandiflorus* Greene; calyx nearly one-half as long as corolla, with its broad subulate teeth one-fourth to one-half the length of the tube or rarely almost equaling it in length; pods glabrate, shiny, straw-color, terete, 2 to 5 cm. long, 3 to 5 mm. wide, abruptly short beaked, the beak of same color as the pod; seeds many, globose, finely granulose.

Reaches its highest development in the desert regions of southeastern California, whence it extends east into Arizona and Utah and southwest into Lower California. In the latter region the plants often have reddish brown, pubescent pods which are less than 3 mm. in width. Distribution Map 3. March–June.

Localities.—Shepherd Cañon, Argus Mountains, Inyo County, *Coville* and *Funston* (U.C. Herb.), duplicate of type of *Lotus argensis* Coville; Shepherd Cañon, Argus Mountains, *Hall* and *Chandler* 7064; rocky slopes, Argus Mountains, *Purpus* 5434, 5737; Pleasant Cañon, Panamint Mountains, Inyo County, *Hall* and *Chandler* 6944; New York Mountains, eastern San Bernardino County, *Parish* 10304; Providence Mountains, *T. S. Brandegee*, May 25, 1902; Cottonwood Mountain, Colorado Desert, *Schellenger* 60; eastern base of San Jacinto Mountains, border of Colorado Desert, *Hall* 1844, 2124, "good match for type of *Hosackia rigida* Benth., but leaflets somewhat broader in the type." Jepson '06, Kew Herb.; border of Colorado Desert at Agua Caliente, San Diego County, *Parish Bros.* 14; Coyote Cañon, *Hall* 2841; Palm Cañon, *Jepson* 1382; Palm Springs, *Parish* 6147; near Toro Mountain, eastern slope, San Jacinto Reserve, *Leiberg* 3177; San Felipe, *T. S. Brandegee*, April 16, 1895, and April 6, 1901; Lower San Felipe Valley, *Jepson* 8723; Vallecito, San Diego County, *Jepson* 8586; Box Cañon, eastern San Diego County, *Jepson* 8657. Lower California: Valledros Creek, *T. S. Brandegee*, May 29, 1893. Arizona: High mountains, Lowell, *W. F. Parish* 38; Valley of the Colorado, *Palmer* 75; Sabina Cañon, *Toumey* 583, 585; Sabina Cañon, *Zuck*, April 4, 1896; Pagumpa, *Jones* 5095f; Verde River, *Smart* 155 in part (U.S. Nat. Herb.); Gila Cañon, *Mohr* 263; Kingman, *Wooton*, March 11, 1912.

References.—Lotus rigidus Greene, Pitt., vol. 2, 1890, p. 142. *Hosackia rigida* Benth., Pl. Hartw., 1848, p. 305, according to Greene, *loc. cit.*, "founded on a specimen of Coulter said to have come from Monterey; but the only plants answering well to the description are from the extreme south of the state and the peninsula beyond." *Anisolotus rigidus* Rydb., Bull. Torr. Club, vol. 33, 1906, p. 144. *Lotus argensis* Coville *in* Contrib. U.S. Nat. Herb., vol. 4, 1893 (p. 83, type loc., Shepherd Cañon, Argus Mountains, Inyo County, *Coville*

and *Funston* 736. Jepson ('06, Kew Herb.) says of a duplicate of Coville's type of *L. argensis*, "the same as *Hosackia rigida* Benth." *Anisolotus argensis* Heller, Muhl., vol. 9, 1913, p. 67.

9. **L. wrightii** Greene (pl. 70, figs. 1–6). Erect, well branched perennials, less coarse than *L. rigidus* Greene, with shorter internodes, more abundant leaves and with flowers distributed for a considerable distance along the stem; leaves short-petioled and subpalmate, even when consisting of more than 3 leaflets; leaflets of the uppermost leaves filiform-linear, those of the lower ones oblanceolate, acute; flowers 1 or 2 in the axils of the leaves, upper ones with peduncles short or absent, lower ones often with elongated peduncles; bract absent or of one linear leaflet; flower 1 cm. or more in length; calyx teeth subulate-setaceous, approaching the length of the tube, entire calyx silky-pubescent; pubescence of herbage less silky; pods reddish brown, silky-pubescent, 1.75 cm. to 3 cm. long, 1.5 mm. to 3.5 mm. wide, the sutures and very short beak yellowish; seeds globose, smooth.

Appearing in the Transition in Arizona, New Mexico, Colorado, and Utah. Considerable variation occurs in leaves and in length of peduncles. Most of the plants from Utah, which were studied, have broader leaflets and longer peduncles with 3 to 5 flowers. May-September.

Localities.—New Mexico: Stony hills at the copper mines, *Wright* 1000; Rio Navajo, *Newberry*, July 26, 1859; in the Valley of the Rio Grande, below Doñana, *Parry, Bigelow, Wright*, and *Schott*, one of the three plants (U.S. Nat. Herb. 23870); Mangas Springs, *Metcalfe*, August, 1901; Balsam Park, Sandia Mountains, *Ellis* 106; vicinity of Brazos Cañon, *Standley* and *Bollman* 10679; vicinity of Chama, *Standley* 6568; Wheeler's Ranch, *Wooton*, July 11, 1906; dry hills, Jicarilla Apache Reservation, near Dulce, *Standley* 8091; Fort Bayard, *A. Mulford* 421; Luna, *Wooton*, July 28, 1900; mountains southeast of Patterson, *Wooton*, August 16, 1900; Burro Mountains, *Blumer* 1833; northwest peak of Burro Mountains, *Wooton*, August 18, 1902; near Alma, *Wooton*, July 24, 1900; West Fork of the Gila, Mogollon Mountains, *Wooton*, August 6, 1900; Fort Wingate, *Rothrock* 152 in 1874; Mimbres River, Grant County, *Metcalfe* 1043; Hanover Mountain, *Holzinger*, July 29, 1911. Colorado: Rockwood, *Tweedy* 461; ten miles east of Bayfield, *Wooton* 2625; Arboles, *Baker* 430; southwestern Colorado, *T. S. Brandegee* 1055 (U.C. Herb.); Dolores, *Crandall*, June 17, 1892 (leaflets tend to be broader than is typical). Utah: Juniper Mountains, *Purpus* 6243; Utah, *Ward* in 1875; Salina Cañon, *Jones* 5412c; southern Utah, *Palmer* in 1877; Summit, southern Utah, *Jones*, June 21, 1890; on the divide between Brine Creek and Grass Valley, *Ward* 316; Utah, *Bishop* 145; Burrville Sink, *Jones* 5638c; Panguitch Lake, *Jones* 6015m; Springdale, *Jones* 5249f; Jugtown, *Jones* 5399; Marysvale, *Jones* 5375k, 5355g, 5338j; along Sevier River, below Marysvale, *Rydberg* and *Carlton* 6979; south end of Fish Lake, *Rydberg* and *Carlton* 7539; mountains south of Glenwood, *Ward* 146. Arizona: Grand Cañon, *Wooton*, July 11, 1892; Grand Cañon, *Toumey* 545c; Grand Cañon, *Hitchcock* 58; near Flagstaff, *Pearson* 23; Flagstaff, *Rusby* 1542; Flagstaff, *MacDougal* 145; Flagstaff, *Jones* 3982; Prescott, *Zuck*, August

14, 1896; Prescott, *Griffiths* 4895; mountains near Williams, *Toumey* 545B; Williams, *Greene*, July 5, 1889; Chiricahua Mountains, *Goodding* 2334 (all of the peduncles elongated); dry washes near Partridge, San Francisco Mountains, *Leiberg* 5680; San Francisco Mountain, *Knowlton* 8; about Mormon Lake, *MacDougal* 89; Rincon Mountains, *Neally* 236 (flowers all long peduncled); Rincon Mountains, *Neally*, 235; St. John's to White Mountains, *Griffiths*, 5202; Black River, White Mountains, *Goodding* 695; head of White River, White Mountains, *Goodding* 662; Twelve-Mile Creek, White Mountain Indian Reservation, *Coville* 1124; Bonita Creek, White Mountains, *Goodding* 1247; Bradshaw Mountains, *Toumey* 586; Willow Spring, *Palmer* 525; Cave Creek Cañon, *Lemmon* and *Lemmon*, August, 1884.

It has been suggested that *Hosackia wrightii* Gray (*Lotus wrightii* Greene) is too near *H. puberula* Benth. (*L. puberulus* Greene), to be a distinct species; but if my assumption, that the specimens in the Herbarium of the U.S. National Museum from Mexico cited below are typical *L. puberulus* Greene, be correct, the two are clearly distinct. The leaves of *L. puberulus* Greene are not in the least subpalmate but are strictly pinnate with 4 to 8 (3) acute linear leaflets. The majority of the plants in the U.S. National Herbarium, from Arizona and New Mexico have subpalmate leaves and seem more closely akin to *L. wrightii* Greene than to *L. puberulus* Greene. The Mexican plants cited below are assumed to be typical of *Hosackia puberula* Benth., since Bentham's type of *H. puberula* came from near Zacatecas, Mexico. The plants listed herewith are clearly *L. puberulus* Greene not *L. wrightii* Greene.—Mexico: in the Sierra Madre, State of Zacatecas, *Rose* 3756; near Plateado, Zacatecas, *Rose* 2776; Ojo Caliente, Zacatecas. *Jones* 151; San Luis Potosi, *Schaffner* 614, 615/819; in the region of San Luis Potosi, *Parry* and *Palmer* 141; base of San Luis Mountains, *Mearns* 2120; cañon east side San Luis Mountains, *Mearns* 2200; near Colonia Garcia in the Sierra Madre, Chihuahua, *Townsend* and *Barber* 93; as above, *Nelson* 6223; southwestern Chihuahua, *Palmer* 433; between Santa Gertrudis and Santa Teresa, Tepic, *Rose* 2113; Otinapa, Durango, *Palmer* 383; Sierra de Los Alamos, *Palmer* 343; San José Mountains, Sonora, *Mearns* 1764. New Mexico: El Capitan Mountains, *Earle* and *Earle* 198; White Mountains, *Wooton* and *Standley* 3502; Organ Mountains, *Wooton* 530; Hermits Peak, *Snow* 1542; Las Vegas, *Dewey*, June 24, 1891; Las Vegas, Hot Springs, *Geo. B. Grant* 5540; Hot Springs, *Snow*, August, 1882; Expedition from Western Texas to El Paso, *Wright* 137.

Var. **multicaulis** Ottley n. var. (pl. 70, figs. 7–13). Decumbent or ascending, with many stems arising from a perennial root; leaflets oblanceolate, or those of the lower leaves rounded-obovate, not more than 1 cm. long; flowers 8 to 10 mm. long; calyx teeth midway between those of the species and those of *L. rigidus* Greene; pods 2 to 2.5 cm. long, 2 to 2.5 mm. wide.

Mohave Desert in the vicinity of New York Mountains, eastward into Nevada. Distribution Map 3. April–May.

Localities.—Barnwell, *K. Brandegee*, May, 1911 (type in U.C. Herb.); Providence Mountains, *T. S. Brandegee*, June, 1902; Mohave Desert, New York Mountians, *Jepson* 5461. Nevada: Karshaw, Meadow Valley Wash, *Goodding* 626. These plants differ in many respects from *Hosackia rigidia* var. *nummularia* Jones (Proc. Calif. Acad. Sci., ser. 2, vol. 5, 1895, p. 633) as represented by Jones' 5128, Santa Clara Valley, Utah. In the latter the internodes are long, the leaves above the basal ones with 1 to 3 leaflets; leaflets linear-ovate, acute, the terminal one over 2 cm. long; bract usually present, also linear-ovate; flowers 1.2 to 1.4 cm. long; legumes 2 to 3 cm. long, 3 to 4 mm. wide, yellowish brown. Jones' 5098D, ten miles south of Black Rock Spring, Arizona, and 5125D, Diamond Valley, Utah, are immature plants and one cannot determine with certainty whether or not their fruits and uppermost leaves would, if mature, resemble those of Jones 5128. I have not seen Jones' 5224K, Rockville, Utah, the first of the four specimens cited by Jones following his diagnosis of *Hosackia rigida* var. *nummularia*, but assume that it corresponds to the other three plants.

References.—Lotus wrightii Greene, Pitt., vol. 2, 1890, p. 143. *Hosackia wrightii* Gray, Pl. Wright., vol. 2, 1853, p. 42, type loc., stony hills at the copper mines, New Mexico, *Wright* 1000. *Anisolotus wrightii* Rydb. *in* Bull. Torr. Club, vol. 33, 1906, p. 144.

10. **L. argyraeus** Greene (pl. 70, figs. 14–22). Prostrate, much branched, woody perennials, with dense silky pubescence on the leaves, young stems, and calyces; internodes short; leaves often broader than long, with very short petiole and rachis; leaflets 3 to 5, cuneate-oblanceolate or cuneate-obovate to rounded-deltoid, mostly obtuse; umbels ebracteate, 1 to 3-flowered; peduncles exceeding the leaves; flowers 8 to 10 mm. long, the subulate calyx teeth a little more than one-half as long as the tube; legumes variable, 1 to 2.2 cm. long, 2 to 4 mm. wide, silky-pubescent to glabrate, 2 to several-seeded; seeds oblong-spherical, smooth.

Dry situations, San Bernardino Mountains, south into Lower California. Upper Sonoran and Transition. Distribution Map 3. May–September. Closely allied to *L. mearnsii* Britt. of Arizona and to *Hosackia nivea* Wats. of Lower California.

Localities.—Santa Ana River (about 6500 ft. alt.), *Peirson*, 2266; Holcomb Valley, *Parish Bros.*, 1495; Holcomb Valley, San Bernardino Mountains, *Parish* 10887; Bear Valley, San Bernardino Mountains, *Parish* 3741; Green Valley, San Bernardino County, *Abrams* 2060; Rose Mine, *Parish* 3094, 3097; Coyote Cañon, Santa Rosa Mountain, San Jacinto Mountains, *Hall* 2140; Coyote Cañon near El Toro, *Jepson* 1440; Santa Rosa Mountain, twenty-five miles south of Palm Springs, *Hall*, August, 1897. Lower California: Cantillas Mountains, ten miles from Tres Pozos, *Palmer* 100.

References.—Lotus argyraeus Greene, Pitt., vol. 2, 1890, p. 144. *Hosackia argyraea* Greene, Bull. Calif. Acad., vol. 1, 1885, p. 184, type loc. in the Cantillas Mountains, Lower California, *Orcutt*. *Anisolotus argyraeus* Heller, Muhl., vol. 8, 1912, p. 47.

11. **L. strigosus** Greene (pl. 71, figs. 1–11). Annuals, ascending or decumbent, with many slender branches arising from the crown of the root; herbage and pods appressed-hirsutulous; leaves 1.5 to 2.5 cm. long, with 6 to 10 leaflets scattered along the flattened rachis, one nearly at the base of the leaf and only about one-half the size of the terminal leaflet; leaflets acute, linear-oblong, those of the lower leaves often cuneate-obovate and obtuse; peduncles exceeding the leaves or shorter, the lower ones 1-flowered, those higher up on the stem 2 to 3-flowered; bract when present mostly of one leaflet; flowers 5 to 10 mm. long; pods straight or slightly curved at apex, 2 to 3 cm. long, 2 to 2.5 mm. wide, the beak short and straight; seeds many, granulose, notched at the hilum, quadrate in surface view; in cross-section rounded oblong, not more than 1 mm. in diameter.

Common in sandy situations near the coast from San Francisco south to San Diego County. Distribution Map 4. January–November. The small-flowered plants agree with *L. rubellus* Greene. I do not find the seeds of these distinguishable from those of the large-flowered form of *L. strigosus* Greene, either by shape of seed or by markings of seedcoat, as claimed by Greene.

Localities.—San Francisco, *Jepson* 2632; San Francisco, *Greene*, May 30, 1892, and May 27, 1893; sand hills near the Marine Hospital, San Francisco, *Heller* 6628; sand hills near San Francisco, *C. Baker* 2855; San Francisco, *Blasdale*, June 11, 1893; Lake Merced, San Francisco County, *Michener* and *Bioletti*, November, 1892, and April 23, 1892; Antioch, Contra Costa County, *Chesnut* and *Drew*, April 18, 1889; Steven's Creek Cañon, San Mateo County, *Wright* 74; Temescal Range, *Brewer* 153 (leaves less than 1.5 cm. in length); ridge west of Los Gatos, Santa Clara County, *Heller* 7375 (leaves large, largest ones 3 cm. long with leaflets 3 to 4 mm. wide; flowers 1.4 cm. long); foothills near Stanford University, *C. Baker* 669; Stanford University, *Elmer* 3024; Santa Cruz, *Jones* 2265; Pacific Grove in pine woods, *Heller* 6689, 6818; Pacific Grove, *Elmer* 3574; Pacific Grove, *Chandler* 341; Monterey, *Eastwood*, April 16, 1900; near Gigling Station east of Monterey, *Heller* 6714; Carmel, *Ottley* 1261; on the right bank of the Carmel River three miles above the Mission, *Heller* 6588; Paso Robles, San Luis Obispo County, *Barber* April 9, 1899, and April 25, 1901; Santa Maria, *Summers*; Coast Range north of San Luis Obispo, *Palmer* 78; Santa Ynez Mountains, near Santa Barbara, *T. S. Brandegee* in 1888; Carpinteria, *Brewer* 262; Santa Barbara, *Elmer* 3924; Santa Paula, *Evermann* in 1880; Susana Pass, Ventura County, *Jepson* 8466; Santa Susana Mountains, *Brewer* 206 (leaves less than 1.5 cm. in length); Matilija Cañon, *Peckham*, February 26, 1866; Saugus, *Davy*, March 1, 1901 (three sheets in U.C. Herbarium with leaflets short, and obovate to nearly orbicular); Arroyo Seco, Pasadena, *Ottley* 684; Pasadena, *Ottley* 599; Garvanza, *Braunton* 156; near Inglewood, *Abrams* 3246; Elysian Park, *Braunton* 835; Eaton Cañon, San Gabriel Mountains, *Ottley* 541; near Bassett, Los Angeles County, *Ottley* 668; San Gabriel Wash near Azusa, *Grinnell*, March 29, 1901; Claremont, *C. Baker* 4006 (leaflets obovate to orbicular); North Pomona, *Braunton* 229; Pomona, *Barber*, April 20, 1897; Witch Creek, *Alderson*, April, 1894; Granite, vicinity of San Diego, *Spencer* 94, 95; San Diego, *Dunn*,

April 24, 1891; La Jolla, *Clements* and *Clements* 147; El Cajon Valley, San Diego County, *Orcutt*, May, 1889; Campo, *Abrams* 3567; Riverside, *Thurber*, March, 1903; San Bernardino, *Parish Bros.* 206, 1863; San Bernardino, *Vasey* 122; Whipple's Exploration in 1853–54, *Bigelow* (U.S. Nat. Herb. 23837); Avalon, Santa Catalina Island, *Trask*, March, 1897; Avalon, *Geo. B. Grant*, April 9, 1901.

Intergrades between the species and the variety *hirtellus* are abundant, especially in the southern dry interior portion of the state. Here the specific and varietal characters, including pubescence, shape and texture of leaflets, size of pods and seeds, appear in various combinations and it is often extremely difficult to determine whether a given plant belongs to the species or to the variety. It is among these intergrades that *L. nudiflorus* Greene may be found. Intergrades between the species and the variety *hirtellus:* Santa Rosa Island, *T. S. Brandegee*, June, 1888; Santa Cruz Island, *T. S. Brandegee*, April, 1888; Little Sur, Ventura Cone, Monterey County, *Davy* 7392; Tassajara Hot Springs, Monterey County, *Elmer* 3290; Pajaro Hills, Monterey County, *Chandler* 447 (many of the leaflets oval or obovate); San Luis Mountain, *Summers*, March, "good match for type of *Hosackia nudiflora* Nutt., save the banner is a bit too long. Type plants of same size." Jepson '06, Kew Herb.; San Francisquito Pass, *Hall* 3095; vicinity of Elizabeth Lake, *Hall* 3067; Tujunga Cañon, Los Angeles County, *Ottley* 691; Lytle Creek, San Antonio Mountains, *Ottley* 744; Whitewater, *T. S. Brandegee*, May 14, 1902; Grapevine Cañon, Colorado Desert, *T. S. Brandegee*, April, 1905; wash south side Grapevine Cañon, *Jepson* 8771; Seven Oaks Camp, San Bernardino Mountains, *Geo. B. Grant*, June 11–14, 1901; Bear Valley, San Bernardino Mountains, *Parish* 3063; common on mesas and foothills, San Bernardino County, *Parish*, May, 1887; San Bernardino, *Jepson* 5597; San Bernardino County, *Parry* and *Lemmon* 75; vicinity of San Bernardino, *Parish* 4661 (seeds granulose and rugose); Cajon Cañon, *N. C. Wilson*, June 20, 1893; near San Jacinto, *Leiberg* 3129; Riverside, *Jepson* 1227 (seeds rugose and granulose); Palm Springs, *Geo. B. Grant* 6713; Keene Station, Kern County, *Heller* 7820; Randsburg, Kern County, *Heller* 7684; Kaweah River, eighteen miles east of Visalia, *Woolsey*, March 20, 1898; Hot Springs, Sequoia National Park, *Jardine* 175; New York Falls, Amador County, *Hansen* 751; White Bar, *Hansen* 1317.

Var. **hirtellus** Ottley n. comb. (pl. 71, fig. 12). Pubescence canescently hirsutulous, not appressed; leaves 1 to 2 cm. long; leaflets cuneate-oblanceolate, obovate, or oblong, obtuse, thickish; flowers 8 to 11 mm. long; legumes mostly 3 mm. wide and usually somewhat constricted between the seeds; seeds larger than in the species, granulose and occasionally faintly sinuate-rugose.

Arid situations, southern California north to Hetch-Hetchy. Rarely found with the species along the coast but of more frequent distribution in the interior. Sonoran and Upper Sonoran. Distribution Map 4. April–October.

Localities.—Ridge north of Hetch-Hetchy, dry ground, *Chesnut* and *Drew*, June 29, 1889; Coulterville road into Merced Cañon, Yosemite National Park, *Hall* 8882; Yosemite Falls, *Hall* 8958; hills

near Erskine Creek, *Purpus* 5568; Bakersfield, Calloway Canal, Kern County, *Davy* 1791; under pines, Richardson Cañon, Antelope Valley, *Davy* 2500; Manzana, Antelope Valley, *Davy* 2530; Santa Lucia Mountains, *Jepson* 1658; Liebre Mountains, Los Angeles County, *Abrams* and *McGregor* 372; Mt. Lowe, Los Angeles County, *Ottley* 644; Mt. Wilson, *Ottley* 649; Mt. Wilson, *Geo. B. Grant*, 6792; Fredalba, San Bernardino Mountains, *Abrams* 2790; Waterman Cañon, southern slope of San Bernardino Mountains, *Parish* 5925; vicinity of Chalk Hill, San Jacinto Mountains, *Hall* 2059; San Jacinto Mountain, *Hall* 965; south side of San Jacinto Mountain, *Hall* 1809; Coyote Cañon, western border of Colorado Desert, *Hall* 2776, 1907; Vandeventer Ranch, Riverside County, *Jepson* 1426; Palomar, *Hall* 1948; Witch Creek, San Diego County, *Alderson* 424; Campbell Ranch, Laguna, *Mearns* 3530; Julian, *T. S. Brandegee*, June 12, 1894. Lower California: San Sebastian, *T. S. Brandegee*, April 29, 1889.

References.—LOTUS STRIGOSUS Greene, Pitt., vol. 2, 1890, p. 141. *Hosackia strigosa* Nutt. *in* T. & G. Fl., vol. 1, 1838, p. 326, type loc., dry gravelly hills near Monterey. *Anisolotus strigosus* Heller, Muhl., vol. 3, 1907, p. 101. *Hosackia rubella* Nutt., *loc cit.*, type loc., dry gravelly hills near Monterey. *Lotus rubellus* Greene, *loc. cit. Anisolotus rubellus* Heller, Muhl., vol. 7, 1912, p. 139. *Hosackia nudiflora* Nutt., *loc. cit.*, type loc., gravelly hills near Monterey. *Lotus nudiflorus* Greene, *loc cit. Lotus strigosus* var. *nudiflorus* Jepson, Fl. W. Mid. Calif., ed. 1, 1901, p. 302. *Anisolotus nudiflorus* Heller, *loc. cit.* Var. HIRTELLUS Ottley. *Lotus hirtellus* Greene, *loc. cit.*, p. 142, type loc., high ridges of the mountains north of Hetch-Hetchy Valley, *Chesnut* and *Drew*. *Hosackia strigosa* var. *hirtella* Hall, Univ. Calif. Publ. Bot., vol. 4, 1912, p. 199. *Anisolotus hirtellus* Heller, Muhl., vol. 8, 1912, p. 60.

12. **L. tomentellus** Greene (pl. 71, figs. 13–20). Prostrate; leaves similar to those of *L. strigosus* Greene var. *hirtellus* but pubescence more appressed and pods less than 3 mm. wide; seeds globose to oval, granulose. Barely distinguishable, without recourse to the seeds, from certain desert forms of *L. strigosus* Greene.

A desert species of southeastern California, Arizona, and Lower California. Distribution Map 4. March–May.

Localities.—Hanaupah Cañon, Panamint Mountains, *Jepson* 7061; Panamint Mountains, *Coville* and *Funston* 526 (U.C. Herb. sheet authenticated by Greene according to Coville); Granite Wells, San Bernardino County, *Parish*, 10137; wash between Carrego and Split Mountain, *Parish* 9112; Split Mountain Cañon, Colorado Desert, *Parish* 9113; Palmetto Springs, Colorado Desert, *Stephens* 1003; Barregos Springs, *T. S. Brandegee*, April 17, 1895; Mecca, Colorado Desert, *Hall* 5830; Cañon Springs, Colorado Desert, Riverside County, *Hall* 5823; Cottonwood Springs, Colorado Desert, *Parish* 10842 (seeds rugose); southwestern part of Colorado Desert, San Diego County, *Orcutt*, April 25, 1890; San Felipe, San Diego County, *T. S. Brandegee*, April 16, 1895; San Felipe Wash, *Eastwood*, 2701; Vallecito, San Diego County, *Jepson* 8543. Lower California: Santa Rosalia, *Palmer* 201; San Bartolomé Bay, *Rose* 16233. Arizona: *Palmer* 76;

Lowell, *W. F. Parish* 45. California: McCoy Wash, Colorado Desert, *Hall* 5952 is referred here provisionally—general aspect of *L. tomentellus* but the seeds are rugose rather than granulose or tuberculate and the pods are 1.3 to 1.7 cm. long, curved near the apex and 3 mm. wide.

Reference.—Lotus tomentellus Greene, Pitt., vol. 2, 1890, p. 140, type loc. at Los Angeles Bay, Lower California, *Palmer* 602, "distributed as *Hosackia strigosa.*"

13. **L. salsuginosus** Greene (pl. 72; pl. 73, fig. 1). Prostrate or decumbent annuals, somewhat succulent; pubescence of few short appressed hairs; leaves 2 to 4 cm. long; leaflets mostly 5 or 6, orbicular to obovate, obtuse, the rachis flat; umbels 1 to 5-flowered; peduncles shorter or longer than the leaves, with a bract of 1 to 3 ovate or orbicular leaflets; flowers 8 to 10 mm. long; calyx not quite one-half as long as flower, the teeth as long as the tube or shorter; corolla unlike those of the six preceding species, banner distinctly separated into blade and claw, claw slightly exserted beyond calyx tube, wings obovate, lying on either side of the obtuse keel and surpassing it in length; legumes 1.8 to 3 cm. long, 1.5 to 2 mm. wide, with recurved beak, more or less constricted between the seeds; seeds smooth, globose to obliquely oval.

Common in the coastal counties from Santa Clara County south into Lower California, also appearing on the islands off the coast and extending sparingly into the southeastern part of the state. Distribution Map 4. March–July.

Localities.—Alum Rock Park, Santa Clara County, *Elmer* 4723; Big Sur, Monterey County, *Davy* 7462; Little Sur River, Monterey County, *Davy* 7307; San Luis Obispo, *Jones* 2684; Avila, San Luis Obispo County, *Summers,* June 4, 1885; Santa Lucia Mountains, *Jepson* 1677; Santa Lucia Mountains, *Barber,* May, 1899; Gaviota, Santa Barbara County, *Eastwood* 45; Santa Barbara, *Elmer* 3766; Santa Barbara, *Dunn,* May 27, 1891; Ventura, *Hall* 3131; Hueneme, Ventura County, *Davy,* April 7, 1902, "fair match for Nuttall's type of *Hosackia maritima,*" Jepson '06, Kew Herb.; Casitas Pass, Ventura County, *Hall* 3220; San Francisquito Pass, *Hall* 3094; San Francisquito Cañon, *Parish,* 1891; Santa Monica forestry station, Los Angeles County, *Barber* 106; Santa Monica, *Hall* 3274; Elysian Park, Los Angeles County, *Setchell,* March 13, 1901; Echo Park, *Braunton* 439; Los Angeles, *Geo. B. Grant,* April, 1903; Pasadena, *Geo. B. Grant* 7506; Garvanza, *Geo. B. Grant,* April 20, 1905; Fish Cañon, San Gabriel Mountains, *Ottley* 605; banks of San Gabriel River, *Leiberg* 3387; Reché Cañon, San Bernardino County, *Parish* 2065; Temecula, *Vasey* 126; near Ysidora, San Diego County, *Abrams* 3293; La Jolla, *Clements* and *Clements* 145; San Diego, *Cleveland,* March 9, 1884; Avalon, Santa Catalina Island, *Pendleton* 1375; Avalon, *Trask,* April, 1895; Santa Cruz Island, *Niedermüller,* May 31, 1908; Santa Cruz Island, *T. S. Brandegee,* April, 1888; Santa Rosa Island, *T. S. Brandegee,* June, 1888.

Var. **brevivexillus** Ottley n. nom. (pl. 73, figs. 2–9). Small and prostrate; flowers 3 to 5 mm. long; keel longer than the banner or wings; legumes 1 to 2 cm. long, noticeably constricted between the seeds. A diminutive form of *L. salsuginosus.* The differences in the relative lengths of the petals of the two, especially as the length of the banner in the variety is not constant, are deemed of insufficient value to justify the retention of Greene's species *L. humilis.*

Southeastern California east into Arizona and south into Lower California and Mexico. Also on the islands west of Lower California. Distribution Map 4. March–May.

Localities.—Hanaupah Cañon, Panamint Mountains, Jepson 7061A; Johnson Cañon, Panamint Mountains, *Coville* and *Funston* 564; Colorado Desert, *T. S. Brandegee,* April, 1905; semi-arid places, Colorado Desert, *Wright* 1775 (in part); Coyote Cañon, western border of Colorado Desert, *Hall* 2848; Del Mar, *T. S. Brandegee,* March 28, 1894; Vallecito, San Diego County, *Jepson* 8545. Lower California: San Telmo, *T. S. Brandegee,* May 30, 1893; Patrocinia, *T. S. Brandegee,* April 17, 1889; Lagoon Head, *Palmer* 777; Santa Maria, *T. S. Brandegee;* Cedros Island, *Anthony* 311; Cedros Island, *T. S. Brandegee,* April 2, 1897; San Benito Island, *T. S. Brandegee,* March 28, 1897. Arizona: Lowell, *W. F. Parish* 44; Lowell, *W. F. Parish,* May, 1884; Little Meadow, *Stephens,* June 22, 1902; Yucca, *Jones,* May 15, 1884. Mexico: Sonora, *Pringle,* March 29, 1884.

References.—LOTUS SALSUGINOSUS Greene, Pitt., vol. 2, 1890, p. 140. *Hosackia maritima* Nutt. *in* T. and G., Fl., vol. 1, 1838, p. 326, type loc., Santa Barbara. *Anisolotus maritimus* Heller, Muhl., vol. 8, 1912, p. 48. Var. BREVIVEXILLUS Ottley. *L. humilis* Greene, Pitt., vol. 2, 1890, p. 140, type loc., San Bartolomé Bay, Lower California, *Pond. Hosackia maritima* Nutt., Greene, *loc. cit.*, vol. 1, 1889, p. 288.

14. **L. micranthus** Benth. (pl. 73, figs. 10–16). Diffuse slender annuals; nearly glabrous, leaflets often glaucous; leaves 8 to 16 mm. long; leaflets, 3 to 5, oblong, oblanceolate, or elliptical, obtuse; flowers solitary, 4 to 5 mm. long; peduncles shorter or longer than the leaves; bract of 3 (1 or 2) leaflets; calyx turbinate-campanulate, with subulate teeth nearly as long as the tube or much shorter; petal claws exserted beyond the tube, banner blade short-oblong to nearly orbicular, the wings slightly longer than the acute keel; legumes 1.5 to 2 cm. long, 1 to slightly more than 2 mm. wide, the short beak curved or straight, constricted between the seeds; seeds 5 to 9, suborbicular to short-oblong, less than 2 mm. long.

Fairly common in grassy places in the Sonoran, both in the western part of the state and eastward into the Sierra region. Distribution Map 4. January–August. Plants are frequently found in which the legumes are sinuate on the margins and larger than in the type, with seeds 2 mm. long.

Localities.—Washington: Near Montesano, Chehalis County, *Heller* and *Heller* 3911. Western Oregon, *Howell,* June, 1881. California: Sissons, *K. Brandegee,* July, 1887; sand dunes at mouth of Little River, Humboldt County, *Tracy* 4795; Humboldt Bay, *Chandler* 1136; Alton, Humboldt County, *Tracy* 3647; opposite Buck Mountain, *Tracy* 4111; Fort Seward Ranch Ridge, Humboldt County,

Jepson 1900; near Weaverville, *Yates* 286; Willits, *Jepson* 2499; Fort Bragg, *Davy* 6564; near Fort Bragg, *Ottley* 1505; near Ukiah, Mendocino County, *Bolander* 3920; near Comptche, *Walker* 256; Los Guilicos, *Michener* and *Bioletti*, May 22, 1892; near St. Helena, Napa River basin, *Jepson* in 1893; Howell Mountain, Napa River basin, *Jepson*, April 24, 1893; Bodega, *Chandler* 651A; Olema, Marin County, *Jepson*, March 28, 1897; Fairfax, Marin County, *Ottley* 339; Mt. Tamalpais, *Jepson*, June 11, 1891; Mill Valley, *Ottley* 154; Sausalito, *Ottley* 406; near "Little Grizzly," Berkeley, *Tracy* 770; Fish Ranch, Contra Costa County, *Jepson*, June 9, 1891; Pilarcitos, *Davy* 1045, 1156; foothills near Wellesley Park, San Mateo County, *Abrams* 2414; summit of the first ridge west of Los Gatos, *Heller* 7374; on Salinas road near Del Monte, *Heller* 6774; Pacific Grove, *Heller* 6671; near Monterey, *Brewer* 620; Santa Lucia Mountains, *Hall* 10005; Paso Robles, Santa Lucia Mountains, *Barber* 1024; Santa Susana Mountains, *Brewer* 205; Evey Cañon, San Antonio Mountains, *Johnston* 1277; Kaweah River basin, *Hopping* 172; northeast of Pinehurst, *Ottley* 1393; Jerseydale, Mariposa County, *Hall* 8846; Blochman Ranch, Mariposa County, *Eastwood* 4209; Yosemite Valley, *Abrams* 4482; foot of Yosemite Falls, *Hall* 9120; near French Flat, Tuolumne County, *Ferris* 1548; Gwin Mine, Calaveras County, *Jepson* 1772, 1809; Mokelumne Hill, Calaveras County, *Blaisdell;* vicinity of Ione, Amador County, *Braunton* 1195; Agricultural Station, Amador County, *Hansen* 13; El Dorado County, *Rattan* 1866; Marysville Buttes, Sutter County, *Heller* 11271; grade between Clear Creek and Paradise, Butte County, *Heller* and *Brown* 5531; Dibble Creek, Tehama County, *Jepson*, April 29, 1899. Form with sinuate, larger legumes: Rattlesnake Mountain, *Davy* and *Blasdale* 5335; vicinity of Eureka, *Tracy* 1750; near Red Bluff, Tehama County, *Heller* 12335; Little Chico Creek, *Austin* 702; near Mt. Diablo, *Brewer* 1173; Julian, San Diego County, *T. S. Brandegee,* June 14, 1894; Santa Cruz Island, *T. S. Brandegee* in 1888.

References.—Lotus micranthus Benth., Trans. Linn. Soc., vol. 17, 1837, p. 367. *Hosackia parviflora* Benth. *in* Lindl. Bot. Reg., vol. 15, 1829, under t. 1257, type from northwest coast of North America, *Douglas. Anisolotus parviflorus* Heller, Muhl., vol. 3, 1907, p. 100. According to Greene, *Hosackia microphylla* Nutt. *in* T. and G., Fl. N. A., vol. 1, 1838, p. 326.

15. **L. americanus** Bisch. (pl. 74, figs. 1–7). Erect or ascending annuals, 1.5 to 4.5 dm. tall (or taller), well branched; herbage villous, pilose or nearly glabrous; large leaves on the main branches 2.5 cm. long, other leaves 1 cm. long or less; leaflets typically 3 (some of the largest leaves on vigorous plants often with 4 or 5 leaflets, tips of branches occasionally bearing leaves of but one leaflet), terminal leaflet oblong or elliptical, acute, petiolulate, the two lateral leaflets asymmetrically ovate, nearly sessile and attached near or at the base of the leaf; peduncles exceeding the leaves, often very much reduced on plants flowering late in the season; bract of one leaflet; flowers solitary (rarely in twos), 6 to 9 mm. long; calyx tube short, turbinate-campanulate, the teeth narrowly triangular-subulate, nearly equaling the corolla in length; corolla cream-color or white with banner deeply

veined with rose, wings but faintly veined, the acute keel tipped with yellow and projecting beyond the wings; legumes linear, 2 to 3.5 cm. long, glabrous, 3 to 7-seeded; seeds oblong.

Pacific Coast states east into central United States. Distribution Map 5. May–October. A very variable polymorphic species of wide distribution. *L. americanus* has been divided into several different species, notably by Heller, on the basis of variation in pubescence, number and size of flowers, length of peduncles, and habit. After a careful study of the various forms in the field and of duplicates of Heller's types we conclude that the group is essentially a unit. With the exception of Heller's *Acmispon glabratus* with its relatively short and broad calyx teeth, no qualitative distinction, except that of habit, has been found on which to separate the group into the different divisions.

Localities.—Hornbrook, Siskiyou County, *Copeland* 3495; Yreka, *Heller*, 8001; near Dietz Station, 3800 ft. alt., *Heller*, 11701, "*Acmispon gracilis*"; Sisson, *Jepson*, July–August, 1894; Scott River Valley, *Gilbert* in 1899; near Black Butte, Siskiyou County, *Heller* 12430, "*Acmispon silvicola*" (leaves mostly reduced to one leaflet); Hupa Indian Reservation, *Chandler* 1394; Redwood Creek at crossing of Willow Creek road, Humboldt County, *Tracy* 4386; valley of Van Duzen River, opposite Buck Mountain, *Tracy* 3964, 3973; Hyampon, *Price*, July 5, 1890; Rush Creek Anderlines, Trinity County, *Yates* 429; South Fork of Eel River, Mendocino County, *Tracy* 5067, "villous form" and 5068, "The common form here" (pubescence inconspicuous); near Ukiah, *Purdy;* near Walker's Ranch, Mendocino County, *Davy* and *Blasdale* 1021; near Comptche, *Walker* 315; banks of Russian River, north of Cloverdale, Mendocino County, *Heller* 5834; Santa Rosa, Sonoma County, *Heller* 6051; near Burke's Sanitarium, Sonoma County, *Heller* 5754; Sulphur Banks, Lake County, *Bowman;* Uncle Sam Mountain, Lake County, *Jepson;* Vacaville, *Jepson*, September, 1891; Alamo Creek, Solano County, *Jepson*, September, 1891; Moraga Ridge, *Ottley* 778; Alameda, *Park*, September 1, 1866; Alameda, *Kellogg*, September 1, 1866; Fruitvale near Diamond Cañon, *Walker* 686; Stockton, *Sanford* 70; foothills west of Los Gatos, Santa Clara County, *Heller* 7526; foothills near Stanford University, *C. Baker* 872, 1511; Jolon Ranch, Monterey County, *Brewer* 559; Paso Robles, *Barber*, April 23, 1899; sand hills near the sea, San Luis Obispo County, *Summers*; The Sisquoc, Santa Barbara County, *M. S. Baker*, July, 1895; Topango, Los Angeles County, *Barber* August 3, 1898; Elysian Hills, *Braunton* 396; Pasadena, *Ottley* 598; Aliso Cañon, Los Angeles County, *Barber* 199; Los Angeles, *Geo. B. Grant*, May 18, 1902; Cienega, *Braunton* 626; Cuyamaca, *T. S. Brandegee*, July 6, 1894; Witch Creek, San Diego County, *Alderson*, May, 1894; Ramona, *K. Brandegee*, October, 1903; Boulevard, Laguna Mountains, Imperial County, *McGregor* 89; San Jacinto Mountain, *Anthony*, July 15, 1895; Strawberry Valley, San Jacinto Mountains, *Hall* 2387; Bear Valley, San Bernardino Mountains, *Chandler*, July 29, 1897; Waterman Cañon, San Bernardino County, *Parish* 2286; vicinity of Riverside, *Hall* 154; Claremont, *Chandler*, June 21, 1897; Owen's Valley and at Fort Tejon, *Horn* in 1862–64; Cajon Cañon, *N. C. Wilson*, June 25, 1893; Middle Tule River, *Purpus* 5623; Toll House,

Fresno County, *Hall* and *Chandler* 28; below Sentinel Hotel, Yosemite Valley, *Hall* 9130; Yosemite Valley, *Hall* 9207; Tuolumne County, *Hall* 1579; Hetch-Hetchy, *Jepson* 3409; grounds of Preston School, Amador County, *Braunton* 1061a; four miles east of Placerville, El Dorado County, *Heller* 12553, *"Acmispon aestivalis";* Marston, Plumas County, *Hall* 9387; east of Chico, *Heller* 12651, *"Acmispon sparsiflorus"*; Chico, Butte County, *Heller* 11132; Dry Creek, Butte County, *Heller* 11692; Table Mountain, Olive Ranch, *Heller* 11146, *"Acmispon aestivalis";* Mud Flat on the Newville-Covelo road, Glenn County, *Heller* 11531; Red Bluff, *T. S. Brandegee,* September 20, 1892; near Pitt River Ferry, Shasta County, *Brown* 223.

Var. **minutiflorus** Ottley n. nom. Less robust than the species, usually decumbent, pilose to nearly glabrous; peduncles reduced or longer than the leaves; flowers 4 to 5 mm. long. Undoubtedly but little more than a reduced form growing at high altitudes and under other unfavorable conditions. Distribution Map 5. The various combinations of the different characters render it impossible to separate this small-flowered group into clean cut divisions. June–July.

Localities.—Between Bartlett Springs and Allen Springs, Lake County, *Heller* 12366; Uncle Sam Mountain, Lake County, *Jepson,* July–August, 1892; Fort Bragg, Mendocino County, *Ottley* 1546a, 1552; Eureka, Humboldt County, *Tracy* 3807, 4583, 3536; ocean beach at Humboldt Bay, *Tracy* 5092; Crescent City, Del Norte County *Davy* and *Blasdale* 5945b; in dry swale, near Yreka, Siskiyou County, *Butler* 390; Sisson, *Setchell* and *Dobie,* July 21, 1902; on low sandy moist lava beds, Modoc County, *M. S. Baker,* June–August, 1893; west shore, Egg Lake, Modoc County., *M. S. Baker* in 1893; American Valley, Plumas County, *Austin* 376; Butte Meadows, Butte County, *Heller* 12826, *"Acmispon mollis";* Forest Ranch, Butte County, *Heller* 11625, *"Acmispon mollis";* Chico Meadows, *Heller* 11615; Bear Valley, Nevada County, *Jepson,* July 21, 1898; lower end of Donner Lake, *Heller,* 7019, duplicate of type of *Acmispon glabratus* Heller (calyx teeth shorter and broader than in typical *L. americanus*); Truckee, *Heller* 7059 (duplicate of type of *Acmispon pilosus*); Sierra Nevada Mountains, Placer County, *Carpenter,* August, 1892; Blue Cañon, Placer County, *Walker* 1243; near Cisco, Placer County, *Hall* 8734, 8733; roadside near Tallac, El Dorado County, *Ottley* 1200; roadside, Fallen Leaf, *Ottley* 875, 843; Myers, *Ottley* 938; Antelope, Amador County, *Hansen* 335; Alpine County, *Hansen* in 1892; Kennedy Meadow, Tuolumne County, *A. L. Grant* 893; Yosemite Valley, *Abrams* 4654; Greely Hill above Coulterville, *Jepson,* July 3, 1896; W. Jackson Meadow, *Mainwaring* 511; Kings River Cañon, *Ottley* 1485; Little Kern Lake, Tulare County, *Culbertson* 4287; Victorville, San Bernardino County, *Parish* 10541; Fawnskin Park, San Bernardino Mountains (7200 ft. alt.), *Wilder* 735; woods near Pacific Grove, *Patterson* and *Wiltz;* near French Flat, Tuolumne County, *Williamson* 48 (between species and variety; plant small, villous; flowers 5–6 mm. long; peduncles exceeding the leaves).

References.—Lotus americanus Bisch., Del. Sem. Hort. Heidelb., 1839; Linnaea, vol. 14, 1840: Litt. Bericht., p. 132. *Trigonella americana* Nutt., Gen., vol. 2, 1818, p. 120. *Hosackia americana* Piper,

Contrib. U.S. Nat. Herb., vol. 11, 1906, p. 366. *Lotus sericeus* Pursh, Fl., vol. 2, 1814, p. 489, type loc. on the banks of the Missouri. *Acmispon sericeus* Raf., Atl. Jour., vol. 1, 1832, p. 144. *Acmispon sericeum* Raf., New Fl., part 1, 1836, p. 53. *Hosackia sericea* Trelease ex Branner and Coville in Am. Rep. Geol. Surv. Ark., vol. 4, 1888, p. 174. *Hosackia purshiana* Benth *in* Lindl. Bot. Reg., vol. 15, 1829, under t. 1257, type from northwest coast of North America, *Douglas*. *Lotus purshianus* Clements and Clements, Rocky Mt. Fl., 1914, p. 183. *Hosackia unifoliolata* Hook., Fl. Bor. Am., vol. 1, 1833, p. 135, type loc., shores of the Columbia River, *Scouler*. *Lotus(?) unifoliolatus* Benth., Trans. Linn. Soc., vol. 17, 1837, p. 368. *Hosackia elata* Nutt. *in* T. and G., Fl. N. A., vol. 1, 1838, p. 327. *Hosackia floribunda* Nutt., *loc. cit.*, type loc., plains of the Rocky Mountain Range, towards the Oregon. *Hosackia mollis* Nutt., *loc. cit.*, type loc. gravel bars and sandy shores of the Wahlamet near the Falls. *Acmispon mollis* Heller, Muhl., vol. 9, 1913, p. 62. *Acmispon gracilis* Heller, Muhl, vol. 9, 1913, p. 61, type loc. near Burke's Sanitarium, Sonoma County, *Heller* 5745. *Acmispon sparsiflorus* Heller, *loc. cit.*, p. 63, type loc., Russian River, Mendocino County, *Heller* 5834. *Acmispon aestivalis* Heller, *loc. cit.*, type loc., Santa Rosa, Sonoma County, *Heller* 6051. Var. MINUTIFLORUS Ottley. *Hosackia elata* var. *glabra* Nutt., *loc. cit.*, type loc., gravelly bars of the Wahlamet and Oregon. *Acmispon glabratus* Heller, *loc. cit.* type loc., lower end of Donner Lake, *Heller* 7019. *Hosackia pilosa* Nutt., *loc cit.* *Acmispon pilosus* Heller, *loc. cit.*, p. 64.

16. **L. denticulatus** Greene (pl. 74, figs. 8–14). Erect annuals, 2 to 5 dm. high, with few long coarse branches; stems glabrous or sparingly covered with short appressed hairs; leaves and calyces pilose, the hairs longer and softer than in *L. subpinnatus* Lag.; leaves 1.5 to 3 cm. long; leaflets 3 or 4, narrowly obovate, margins usually denticulate; rachis flat, bearing two leaflets at its apex and one or two on one side; flowers solitary, almost sessile, 6 to 8 mm. long, whitish-cream with back of banner tinged with purple; calyx teeth subequal or the two dorsal ones narrowly triangular and the others nearly linear, as long as or longer than the tube, margins often denticulate; banner short-clawed, blade nearly orbicular; keel attenuately beaked, with upper margin covered by the wings; wings of this and of *L. subpinnatus* Lag. and of *L. humistratus* Greene furnished with a deeper, more nearly triangular lobe or process than any other Californian species of *Lotus;* ovary straight on one margin, rounded on the other, covered with silky hairs; style hooked at base; legumes 1 to 2 cm. long, 3 to 4 mm. wide, covered with short soft appressed hairs, sutures thickened and often denticulate, 2 to 4-seeded; seeds 4 by 2 mm. to 2 by 1 mm., asymmetric, notched at the hilum, with an elevation on one or both sides.

Northern part of California north to British Columbia. Distribution Map 6. May–August. According to Greene, this species "embraces all of *Hosackia subpinnata* of Mr. Macoun's Catalogue."

Localities.—Oregon: Ash Creek, Rogue River Valley, *Austin*, July, 1893. California: near Egg Lake, Modoc County, *Baker* and *Nutting*, June 8, 1894; near Pitt River, Modoc County, *M. S. Baker*, July 28,

1893; along creek near Yreka, *Butler* 912, 389; Yreka Creek, *Butler* 1610 (form with leaves and legumes densely villous); Edgewood, *K. Brandegee*, July, 1887; bank of Mad River, *Chesnut* and *Drew*, July, 1888; Jarnigan's, Humboldt County, *Chesnut* and *Drew*, July 11, 1888; Mad River, *Price*, July 1, 1890; Harris to Fort Seward Ranch Ridge, Humboldt County, *Jepson* 1882; Kneeland Prairie, *Tracy* 3845; valley of Van Duzen River, *Tracy* 2756; near Hydesville, *Tracy* 1240; Chico–Hamilton road, six miles from Chico, *Heller* 11342; Tehachapi, Kern Co., *Greene*, June 21, 1889 (out of range but stem, calyx teeth, and legumes typical *L. denticulatus*).

References.—Lotus denticulatus Greene, Pitt., vol. 2, 1890, p. 139. *Hosackia denticulata* Drew, Bull. Torr. Club, vol. 16, 1889, p. 151, type loc. along Mad River, near Jarnigan's, Humboldt County, *Chesnut* and *Drew*. *Anisolotus denticulatus* Heller, Muhl., vol. 7, 1912, p. 139.

17. **L. subpinnatus** Lag. (pl. 74, figs. 15–20). Closely resembling *L. denticulatus* Greene in many of its technical characters and often distinguished from it with difficulty in herbarium specimens; low, diffusely branched, pilose to nearly glabrous; leaflets 3 to 5, mostly 4; flowers yellow, tinged with reddish purple; calyx teeth usually shorter than the tube; ovary oblong, less hairy than for *L. denticulatus;* legumes 3 to 7-seeded; seeds 2 mm. long by slightly less than 1.5 mm. wide, shape as in *L. denticulatus.*

More or less common in the Sonoran throughout the state. Often found growing side by side with *L. humistratus* Greene. Distribution Map 6. March–October. Upon comparison of certain Californian specimens of the U.C. Herbarium (*Hall* 3841, *Brewer* 360, 1166, see localities) with plants at Kew Herbarium of *Lotus subpinnatus* Lag. collected in Chile, Dr. Jepson found that, in general, the Chilian plants were more pubescent, the leaflets were narrower and were four in number, not five as is often the case with the Californian plants. After a careful study of a large number of plants from different parts of the state and a consideration of the diagnosis of the Chilian type by Lagasca and of the description given by Hooker and Arnott for the species as represented by plants collected at Conception, Chile, I have come to the conclusion that the Californian representatives should be retained within the species. They show as great variation among themselves as with the South American plants. The South American plants are also variable, as may be seen from a comparison of Hooker and Arnott's description with that of Lagasca. The extent of variation is no more than one might expect to find in a species with such a wide range of distribution.

Localities.—Near Trinidad, Humboldt County, *Tracy*, 2967; Yager Creek near Hydesville, *Tracy* 2521; Ukiah, *Purdy* April 13, 1898; Fort Ross, Sonoma County, *Heller* 6599; Bodega Point, *Eastwood*, June 9, 1899; Bodega Bay, *Chandler* 719; Vanden and Little Oak, *Jepson* in 1885; near Napa, *Heller* and *Brown* 5358; Ross Valley, Marin County, *Chandler* 292; Fairfax, *Ottley* 360; Holiday Hill, San Francisco, *Rattan* in 1887; Lands End, San Francisco, *Davy*, June 12, 1896; vicinity of Berkeley, *Walker*, 56; North Berkeley Hills, *Chandler*, March 17, 1900; Berkeley, *Chandler*, 243; U. C. Campus,

Berkeley, *Ottley* 1; Berkeley, *Tidestrom*, April 27, 1893; Livermore Valley, *Davy*, May, 1898; Mt. Diablo, *Brewer* 1166, "very like a specimen from Huasco, Chile, except that this is more glabrous. In general, Chilian specimens show a hairier calyx than do those from California." Jepson '06, Kew Herb.; Mt. Diablo, *Ottley* 458; Moraga Ridge, *Ottley* 779; Knight's Ferry, *Bancroft*, April 9, 1895; Crystal Springs Lake, San Mateo County, *C. Baker* 776; Belmont, San Mateo County, *Elmer* 4741; Evergreen, Santa Clara County, *Davy* 93; foothills near Stanford University, *C. Baker* 774; Alma, *K. Brandegee*, April, 1890 (legumes 4 to 5 mm. wide); San Juan, San Benito County, *Elmer* 5024; in pine woods, Pacific Grove, *Heller* 6670; Pacific Grove, *Elmer* 3573; Cambria, *Condit*, June 13, 1912; Santa Lucia Mountains, *Barber*, March 30, 1900; Santa Barbara, *Brewer* 360, "very like a specimen of *Lotus subpinnatus* Lag. from Rancagua, Chile, but the Chilian one is somewhat more hairy and the leaflets in this, on the whole, broader and 5 instead of 4," Jepson '06, Kew Herb.; Santa Cruz Island, *T. S. Brandegee* in 1888; in field near Arroyo Seco, Los Angeles County, *Ottley* 636 (calyx teeth denticulate and slightly longer than tube); North Pomona, *Braunton* 228; San Diego, *Jones* 3162; Witch Greek, *Alderson*, April, 1894; southwestern part of Colorado Desert, San Diego County, *Orcutt* in 1889; Midlands, Riverside County, *Hall* 3841, "quite like *Lotus subpinnatus* Lag. as represented by *Cuming* 289 Valparaiso, Chile, Kew Herb., save that the hairs are a trifle shorter and the leaflets mostly 5 instead of 4," Jepson '06, Kew Herb.; bluffs of Kern River, Kern County, *Heller* 7632; Marysville, Kern County, *Heller* 7554; Orosi, *Goldman* 5; near Badger, *Ottley* 1413; Wright's, seventeen miles west of Los Baños, *Wooton*, April 3, 1912; east of Berenda, *Wooton*, April 7, 1912; near French Flat, Tuolumne County, *Ferris* 1543; Mokelumne Hill, Calaveras County, *Blaisdell;* San Joaquin County, *C. Baker* 2777; base of South Peak, Marysville Buttes, *Jepson*, April 20, 1891; Marysville Buttes, Sutter County, *Ferris* 657; seven miles west of Arbuckle, Colusa County, *Ferris* 577; Stilson Cañon, east of Chico, *Heller;* near Clear Creek, Butte County, *Brown* 182.

References.—LOTUS SUBPINNATUS Lag., Gen. and Sp. Pl., 1816, p. 23, type loc., Talcahuano, Chile. *Lotus subpinnatus* Lag., Hook. and Arn., Bot. Beech., 1830, p. 17, pl. 8, Conception, Chile. *Hosackia subpinnata*, T. and G., Fl., vol. 1, 1838, p. 326. *Lotus wrangelianus*, F. and M., Ind. Sem. Hort. Petrop., 1835, no. 41, p. 16, type loc., Bodega Bay; Linnaea, vol. 11, 1837: Litt. Bericht., p. 110; transcript in Erythea, vol. 2, 1894, p. 149. *Hosackia wrangeliana*, T. and G., Fl., vol. 1, 1838, p. 326. *Lotus subpinnatus* var. *wrangelianus* Jepson, Fl. W. Mid. Calif., ed. 1, 1901, p. 303. *Lotus macraei* Benth., Trans. Linn. Soc., vol. 17, 1837, p. 367, type loc., Valparaiso, Chile, *Macrae.*

18. **L. humistratus** Greene (pl. 74, figs. 21–27). Closely resembling *L. subpinnatus* Lag. in general habit and appearance, distinguishable from it by a denser villous pubescence, by the longer calyx teeth (usually twice as long as the calyx tube) and by the shorter pod; ovary similar to that of *L. denticulatus* Greene; legumes commonly straw-color, 7 to 10 mm. long, 3 mm. wide; seeds 2 to 5 (mostly 3), in shape resembling those of the two preceding species.

Distribution in the state as for *L. subpinnatus* Lag. Distribution Map 6. In Arizona and New Mexico. April–July. Plants cited below from the Mohave Desert and from near Lancaster (type loc. for *L. trispermus* Greene) are referred to this species since they appear to be nothing other than small plants of *L. humistratus*. *L. trispermus* Greene therefore is not accepted as a distinct species.

Localities.—Goosenest foothills, Siskiyou County, *Butler* 1623; Hupa Indian Reservation, *Chandler* 1308, "very close to type specimen of *Hosackia brachycarpa* Benth. The pods in this are a trifle (1 or 2 mm.) longer." Jepson '06, Kew Herb.; Fort Seward Ranch Ridge, Humboldt County, *Jepson* 1897; Kneeland Prairie, *Tracy* 3833; valley of Van Duzen River, *Tracy* 2701; Yager Creek near Hydesville, *Tracy* 2531 (some of the pods more than 1 cm. long); north of Weaverville, *Yates* 302; near Pitt River Ferry, Shasta County, *Brown* 226; near Redding, Shasta County, *Heller* 7848; near Comptche, *Walker* 361; near Alder Springs, Glenn County, *Heller* 11465; Allen's Springs, Lake County, *Cleveland*, June 17, 1882; Mt. St. Helena, *C. Baker* 2605; Jerusalem Valley, Lake County, *Jepson* 9035; Hood's Peak, Sonoma County, *Michener* and *Bioletti*, June, 1893; near Mark West Springs, Sonoma County, *Heller* and *Brown* 5288; trail to Caux's Cabin, Napa River Basin, *Jepson*, April 25, 1893; Walker Cañon, Solano County, *Jepson*, May 17, 1892; Sacramento River, *Baker* and *Nutting*, May 20, 1894; Ross Valley Hills, Marin County, *Jepson*, April 10, 1897; Fairfax, Marin County, *Ottley* 359, 371; Mt. Tamalpais, *Chandler* 261; Mt. Tamalpais, *Heller* 8390; dry west slope of Grizzly Peak, Alameda County, *Tracy* 1420; Lake Temescal, Alameda County, *Jepson*, June 14, 1891; on dry rocky hills, Mt. Diablo Range, *Brewer* 1073, "of all our specimens in the herbarium of the University of California this is the nearest Bentham's type of *Hosackia brachycarpa*." Jepson '06, Kew Herb.; Mt. Diablo, *Ottley* 482; *Belmont*, San Mateo County, *Elmer* 4722; summit of the first ridge west of Los Gatos, *Heller* 7392; Stanford University, *Abrams* 2400; foothills near Stanford University, *C. Baker* 659; trail to Manzana Creek, Santa Barbara County, *Eastwood* 659; Seymour Creek, Mt. Pinos, *Hall* 6341; near Lancaster, *Davidson;* Cajon Pass, San Bernardino County, *Parish* 9276; near Victorville, *Hall* 6202; Kramer, San Bernardino County, *K. Brandegee* in 1914; Mohave Desert, *Parish Bros.* 1272; desert west from Piute Creek, *N. C. Wilson*, June 12, 1893; Barnwell, *K. Brandegee*, May, 1911; Granite Wells, San Bernardino County, *Parish* 10137; mesas, Argus Mountains, *Purpus* 5420; near Independence, Inyo County, *Hall* and *Chandler* 7299; Kaweah, *Hopping* 279; Copperopolis, Calaveras County, *Davy* 1339; road to Calaveras Grove, *T. S. Brandegee*, July 7, 1890; near Plymouth, Amador County, *Gross* in 1903; Nevada City, *Eastwood* 609; plains near Chico, Butte County, *Austin* 46; on the Clear Creek-Paradise grade, Butte County, *Heller* 11377. Arizona: near Kingman, *N. C. Wilson*, June, 1893, "very near type of *Hosackia brachycarpa* Benth. Calyx teeth in this are not quite as long." Jepson '06, Kew Herb. New Mexico: Mangas Springs, *Metcalfe*, 14.

References.—Lotus humistratus Greene, Pitt., vol. 2, 1890, p. 139. *Hosackia brachycarpa* Benth., Pl. Hartw., 1848, p. 306, type loc. in mountains of Sacramento. *Anisolotus brachycarpus* Rydb. *in* Bull.

Torr. Club. vol. 33, 1906, p. 144. *Lotus trispermus* Greene, Erythea, vol. 1, 1893, p. 258, type loc., Lancaster, *Davidson*. *Anisolotus trispermus*, Woot. and Stand., Contrib. U.S. Nat. Herb., vol. 16, 1913, p. 135.

19. **L. nuttallianus** Greene (pl. 75, figs. 1–8). Prostrate annuals with long slender branches; leaves, calyces, and young stems thinly hirsutulous, older stems glabrate; largest leaves 2 cm. long, with 5, 6, or 7 leaflets, cuneate-oblanceolate, acute or obtuse; umbels several-flowered; peduncles exceeding the leaves; bract when present mostly of one leaflet; flowers 5 to 7 mm. long; calyx less than one-half as long, with teeth triangular and about one-third the length of the tube or shorter; ovary in fruit slender, arcuate, constricted between the two seeds, much exceeding the calyx and terminated by a long involute glabrous style.

Occurring in the southern part of the state near the sea and south into Lower California. Range limited. Distribution Map 7. April–June.

Localities.—Santa Barbara, *Nuttall* (label reads **Drepanolobus prostratus*), doubtless an incorrect locality; Del Mar, San Diego County, *Jepson* 1602a, "an excellent match of Nuttall's type of *Hosackia prostrata.*" Jepson '06, Kew Herb.; Del Mar, *Eastwood* 2967; Del Mar, *T. S. Brandegee*, May 16, 1894; North Island, Coronado, *Chandler* 5170; Coronado Beach, *Berg*, September 3, 1904; Coronado Beach, *K. Brandegee*, June 2, 1889; San Diego, *Eastwood* 9272; near the sea, San Diego, *Stokes* in 1895; Chula Vista, near San Diego, *Collins* and *Kempton* 52; Tia Juana Wash, San Diego County, *Hall* 3958; Tia Juana, *Abrams* 3486j.

References.—Lotus nuttallianus Greene, Pitt., vol. 2, 1890, p. 150. *Hosackia prostrata* Nutt. *in* T. and G. Fl., vol. 1, 1838, p. 325, type loc., "Santa Barbara" (?), *Nuttall*. *Syrmatium prostratum* Greene, Bull. Calif. Acad., vol. 2, 1886, p. 147. *?Hosackia decumbens* var. *glabriuscula* Hook and Arn., Bot. Beech., 1832, p. 137, according to Watson's Index to N. A. Bot., 1878, p. 226.

20. **L. hamatus** Greene (pl. 75, figs. 9–17). Very similar to *L. nuttallianus* Greene in general aspect, but differing in the following technical characters: flowers 3 to 4.5 mm. long, in sessile or nearly sessile umbels; calyx one-half the length of the flower; wings not longer than the keel; style appressed-hairy.

Occasional in sandy soils of Los Angeles, San Diego, San Bernardino and Riverside counties, on Santa Catalina Island, and in Lower California. Distribution Map 7. March–June.

The plants are more herbaceous, with pubescence less appressed and somewhat more abundant than in *L. nuttallianus* Greene.

Localities.—Coronado, San Diego County, *Geo. B. Grant* 6831; vicinity of San Diego, *Spencer* 91; San Diego, *K. Brandegee*, April, 1906; vicinity of San Diego, *Wright* 37, 132; San Diego, *T. S. Brandegee* 1619; Mission Hills, San Diego, *Abrams* 3403; mesa near San Diego, *Stokes* in 1895; Jamacha, *Chandler* 5271; Descanso, *T. S. Brandegee*, May 24, 1906; Swetzer Cañon, *Alderson* 2217; Menifee, Riverside County, *M. A. King* in 1893; Palm Springs, *Peirson* 714;

San Bernardino Valley, *Parish* 5586; plains near San Bernardino, *Parish* 2172; Red Hill near Upland, *Johnston* 1193; Garvanza, Los Angeles County, *Eastwood* 62; Little Tujunga Wash, *Ottley* 587; hill at entrance to Tujunga Cañon, *Ottley* 693; plains near Colton, *Parish* 2072; Santa Catalina Island, *Davidson* 3. Lower California: San Pablo, *T. S. Brandegee,* April 21, 1889.

References.—Lotus hamatus Greene, Pitt., vol. 2, 1890, p. 150. *Hosackia micrantha* Nutt. *in* T. and G. Fl., vol. 1, 1838, p. 324, type loc. "near Monterey." According to notes Jepson '06, Kew Herb.: "The label on Nuttall's specimen is in his hand, the loc. Monterey, the plant is typical *strigosus.* It is plainly conspecific with Heller's Monterey, 6818, U.C. Herb. '*Drepanolobus micranthus*, Isl. Catalina, U. C.'* Label in Nuttall's hand. This plant is *Lotus hamatus* Greene."

21. **L. leucophyllus** Greene (pl. 76, figs. 1–8). Silky-canescent perennials, with stems long and procumbent, bearing leaves with three approximate leaflets; leaflets elliptical (oblanceolate), acute, variable in width—1 to 8 mm.; umbels sessile or nearly so, consisting of but 1 to 3 (5) flowers 6 to 9 mm. long; calyx nearly one-half length of flower, the narrowly linear teeth nearly one-half length of tube; claws of petals exserted; wings longer than the keel; legumes silky-canescent, straight or falcate, slender, much exceeding the calyx; seeds 2 to several, rounded-oblong.

Upper Sonoran and Transition from San Benito and Monterey counties east to Inyo County. Distribution Map 7. April–July. Apparently includes Greene's *Hosackia procumbens.* The calyx teeth of the type of the latter are not so nearly triangular nor so different in other ways from those of *L. leucophyllus* as one would be led to think from reading Greene's diagnosis. *Hosackia procumbens* Greene is midway between *Hosackia sericea* Benth. and the variety proposed below.

Localities.—Near Pinnacles, San Benito County, *Hall* 9963; Upper Salinas Valley, *Brewer* 521; along grade, Jolon to King City, Monterey County, *Dudley* in 1895; Jolon, *Vasey* 121, July, 1880 (parts of two plants, on one the pods short and fat, mostly 5 to 6 mm. long and 2 mm. wide, straight on one side and curved slightly on the other, on the other plant the pods varying in length from 4 to 14 mm.); Jolon, *K. Brandegee,* June 8, 1909; dry hills near Mission San Antonio, Santa Lucia Mountains, *Jepson* 1666 (legumes strongly arcuate); Templeton, San Luis Obispo County, *Barber* A25, "good match for type of *Hosackia sericea* Benth," *Jepson* '06, Kew Herb.; Griffins, Ventura County, *Elmer* 3988, July, 1902 (calyx teeth broadly triangular, short); Frazier Mountain, Ventura County, *Hall* 6603; Mt. Pinos, *Hall* 6494, 6536; east slope of Walker Pass, Kern County, *Coville* and *Funston* 1017; Poso Flat, Greenhorn Range, Kern County, *Hall* and *Babcock* 5025; Tehachapi, *Curran* in 1884 (duplicate of Green's type of *Hosackia procumbens*); region of Tehachapi Peak, *Dudley* 324a; rim of Mohave Desert (6000 ft. alt.), *Hall* 1254; Tejon Pass, *Hall* 6264; vicinity of Fort Tejon, *Abrams* and *McGregor* 277; in Owen's

* Upper California.

Valley and at Fort Tejon, *Horn* in 1863; Llano Verdi, Antelope Valley, *Davy* 2312; Manzana, Antelope Valley, *Davy* 2502; hills south of Antelope Valley, *Hall* and *Chandler* 7392; Mohave River district, *Palmer* 80; Mohave Desert, *Parish* 3740; Mohave Desert near head of Cajon Pass, *Parish* 10911 (pods immature, but some as much as 2 cm. long); Cajon Pass, *Cooper,* June 8, 1861; Rock Creek, Mohave Desert, *Davidson,* July, 1893; Bryne's Spring, San Bernardino Mountains, *Parish* 3193. Pods strongly arcuate: Independence, Inyo County, *Rhine* 655; sunny slopes, Argus Mountain, *Purpus* 5465 (in U.S. Nat. Herb.), duplicate in U.C. Herbarium has pods curved to form almost a circle.

Var. **jepsonii** Ottley n. var. Ascending; flowers 1 to 2 in the leaf axils, 9 to 12 mm. long; calyx teeth between 2 and 3 mm. long and over one-half the length of the tube; claws of petals scarcely exserted. —Eastern part of the range of the species. Distribution Map 7. July.

Localities.—Kern River, near Little Kern Lake, *Jepson* 4921 (type); vicinity of Lloyd Meadow, Kern River, *Dudley* 798; Greenhorn Mountains, *Purpus* 5533; Trout Meadows, Tulare County, *Purpus* 1856; gravelly ridges around Trout Meadows, *Hall* and *Hall* 8385.

References.—Lotus leucophyllus Greene, Pitt., vol. 2, 1890, p. 149. *Hosackia sericea* Benth., Trans. Linn. Soc., vol. 17, 1837, p. 367, type from California, *Douglas* in 1833. *Syrmatium sericeum* Greene, Bull. Calif. Acad., vol. 2, 1886 p. 147. *Hosackia procumbens* Greene, *loc. cit.,* vol. 1, 1885, p. 82, type loc., Tehachapi, Kern County, *Curran. Syrmatium procumbens* Green, *loc. cit.,* vol. 2, 1886, p. 147. *Lotus procumbens* Greene, Pitt., vol. 2, 1890, p. 149.

22. **L. scoparius** Ottley n. comb. (pl. 77, figs. 1–9). Suberect bushy perennials, 4 to 12 dm. tall, with long virgate branches bearing sessile umbels extending back from the tip for many centimeters; stem hard, green, striate, with stipular ridge prominent; herbage glabrous except at young growing ends of the stems; leaves 1 to 2 cm. long; leaflets 3 (4 or 5), acute, oblong or oblanceolate (oval); flowers 8 to 10 mm. long; calyx teeth short-subulate; claws of petals exserted slightly beyond calyx tube; wings equal in length to the keel; legumes falcate to almost straight, extending far beyond the calyx, 1 or 2-seeded.

Common in the Upper Sonoran of the western part of the state and in the Sierra Nevada, so abundant in certain regions as to be classed among the weeds. In the vicinity of Pasadena it often fills vacant city lots. It varies much in size, in habit, and in abundance of flowers. One mainland and several island varieties may easily be distinguished. Distribution Map 8. February–October.

Localities.—On bluffs, South Fork, Eel River, Humboldt County, *Tracy* 3801, 5048; Mendocino and Ukiah road, *McMurphy* 137; near Clear Lake, *Torrey* in 1865; Healdsburg, Sonoma County, *King,* June, 1897; near St. Helena Sanitarium, *Abrams* 5770; Weldon Cañon, Solano County, *Jepson,* June 1, 1891; along Sonoma Creek at foot of Mt. Hood, *Heller* 5777; Howell Mountain, *Jepson,* June, 1893; Buckeye Creek, Yolo County, *Stinchfield* 321; Bolinas Bay, *Setchell,* March 6, 1896; Mt. Tamalpais, *K. Brandegee* in 1905; Mill Valley, *Walker*

635; sand hills near San Francisco, *C. Baker* 2997; North Berkeley Hills, *Walker* 608; Moraga Ridge, Ottley 773; Antioch, *K. Brandegee,* May, 1907; San Leandro, *Eastwood* 4735; hills south of Niles Cañon, *Ottley* 752; Colma, *Ehlers* 269; near Orestimba, Stanislaus County, *Brewer* 1278 (June 16, 1862); foothills west of Los Gatos, Santa Clara Co., *Heller* 7485; Big Sandy Creek, Fresno County, *McDonald* in 1915; on Salinas road near Del Monte, *Heller* 6836; Monterey, *McLean,* June, 1873; Carmel, *Ottley* 1262; near Jolon Ranch, Monterey County, *Brewer* 581; San Luis Obispo County, *Summers* 284; Templeton, *Davy* 7639; mesa slopes near Santa Barbara, *Eastwood* 144; Santa Ynez Mountains, near Santa Barbara, *T. S. Brandegee* in 1888; Santa Barbara County, *Torrey* 105 in 1865; Santa Monica coast, *Barber* 374; Elysian Park, Los Angeles, *Setchell,* March 13, 1901; Hermosa Beach, Los Angeles County, *Parish* 11665; San Diego, *K. Brandegee,* May, 1906; vicinity of San Diego, *Spencer* 90; Del Mar, *T. S. Brandegee,* May 16, 1894; Riverside, *Johnston* 1236; near Caliente, Kern County, *Heller* 7624; hills near Springville, *Purpus* 1314; Rawhide Hill, Tuolumne County, *Williamson* 111; Gwin Mine, Calaveras County, *Jepson,* October 6, 1902; Calaveras Valley, *K. Brandegee;* West Point Bridge, *Hansen* 1811 (few flowers); Amador County, *Hansen* in 1892. Calyx teeth triangular with a prominent vein running through the center and ending in a subulate point: Redondo, *K. Brandegee,* October, 1893; San Diego, *T. S. Brandegee* 1605; southern part of San Diego County, *Palmer* 58; Tia Juana, *Abrams* 3469; Playa del Rey, *Abrams* 2518. Calyx teeth linear, with or without the prominent vein, over one-half the length of tube: Witch Creek, San Diego County, *Alderson* in 1893 and April and May, 1894.

Var. **veatchii** Ottley n. comb. Decumbent; calyces, leaflets and young stems silky-pubescent, with appressed hairs; leaflets oblanceolate, obtuse; umbels nearly sessile; flowers 1 to 1.2 cm. long, wings longer than the keel; calyx teeth short-triangular; legume 2-seeded.—Islands of Lower California and California. Distribution Map 8.

Localities.—San Miguel Island, *Greene* in 1886 (type of *Syrmatium patens* Greene). Elide opposite Cedros Island, *Veatch* (type of *Hosackia veatchii* Greene).

Var. **dendroideus** Ottley n. comb. Erect, 12 to 21 dm. high, more woody than the species; leaves larger, leaflets 3 or 4, oblong or oblanceolate, 8 to 15 mm. long; umbels short-pedunculed; flowers 1 to 1.2 cm. long; fruit 2 or 3-seeded and longer than in the species.—Insular. Distribution Map 8. January–August.

Localities.—Santa Cruz Island, *Greene* in 1886 (type of *Syrmatium dendroideum* Greene); Santa Cruz Island, *Swain* in 1919; Frey's Harbor, *Niedermüller,* May, 1908, "bushy, 2 ft. woody at base"; Santa Cruz Island, *T. S. Brandegee,* April, 1888; Santa Cruz Island, *Franceschi* in 1894; Santa Cruz Island, *Greene,* July and August, 1886; Santa Rosa Island, *T. S. Brandegee,* June, 1888; Santa Catalina Island, *Davidson* 6 in 1891; Santa Catalina Island, *Grant* and *Wheeler,* April 21–26, 1904; Avalon, *Geo. B. Grant,* March 29, 1900.

Var. **traskiae** Ottley n. comb. Erect; umbels pedunculate with or without a bract of one leaflet, few-flowered, more delicate looking than those of the variety above; claws of petals conspicuously exserted; calyx teeth short subulate-triangular; leaflets 5 to 9 mm. long, oblanceolate, obtuse.—Insular. Distribution Map 8.

Locality.—Avalon, Santa Catalina Island, *Trask* in 1897.

Var. **brevialatus** Ottley n. var. (pl. 77, figs. 10–16). Flowers .8 to 1 cm. long; banner short; keel extending noticeably beyond the wings, which curve upward toward banner.—Southern California. Distribution Map 8.

Localities.—Vicinity of San Diego, *Spencer* 92; San Diego, *Stokes* in 1895; Jacumba, *Abrams* 3652; Cuyamaca (Talley's), *Dunn*, June, 1889; Reché Cañon, Riverside County, *Hall*, May 15, 1900; Box Cañon, below Blair Valley, east San Diego County, *Jepson* 8671; San Antonio Cañon near Upland, *Condit*, June 1; vicinity of San Bernardino, *Parish*, 4776; San Bernardino Valley, *Parish* 7134; Claremont, *Chandler*, May 11, 1897; Little Tujunga Wash, *Ottley* 589 (type); Los Angeles County, *Barber* July 8, 1898 (banner not short); Los Angeles, *E. D. Palmer*, February, 1902; Augustine Ranch, Palomar, *Jepson* 1558; Cajon Cañon, *N. C. Wilson*, June 25, 1893; vicinity of Havilah, Kern County, *F. Grinnell* 296 (U.S. Nat. Herb.).

References.—LOTUS SCOPARIUS Ottley. *Hosackia scoparia* Nutt. *in* T. and G. Fl., vol. 1, 1838, p. 325. *Syrmatium glabrum* Vogel, Linnaea, vol. 10, 1836, p. 591, type from California. *Hosackia glabra* Torr., Bot. Wilkes Exp., 1874, p. 274, type loc. near San Francisco. *Lotus glaber* Greene, Pitt., vol. 2, 1890, p. 148 (not of Mill.). *Hosackia crassifolia* Nutt., *loc. cit.*, type loc., dry hills near the sea, Santa Barbara. *H. glabra* var. *diffusa* Gray, Proc. Acad. Phila., vol. 15, 1863, p. 346. *Lotus diffusus* Heller, Cat. N. Am. Pl., ed. 2, 1900, p. 7. Var. VEATCHII Ottley. *Hosackia veatchii* Greene, Bull. Calif. Acad., vol. 1, 1885, p. 83, type loc. at Elide, Lower California, *Veatch*. *Lotus veatchii* Greene, Pitt., vol. 2, 1890, p. 148. *Syrmatium patens* Greene, Bull. Calif. Acad., vol. 2, 1886, p. 147, type loc., San Miguel Island, Lower California. Var. DENDROIDEUS Ottley. *Syrmatium dendroideum* Greene, Bull. Calif. Acad., *loc. cit.*, p. 146, type loc., Santa Cruz Island. *Lotus dendroideus* Greene, Pitt., vol. 2, 1890, p. 148. Var. TRASKIAE Ottley. *Syrmatium traskiae* Eastw. (in herb.), Abrams, Fl. Los Angeles, 1917, p. 201, type loc., Mosquito Harbor, San Clemente Island, *Trask* 287.

23. **L. benthamii** Greene (pl. 76, figs. 9–16). Suffrutescent perennials, decumbent to suberect, with many branches from the crown of the woody root; glabrous except on young herbage; gland-like stipules prominent; leaves short; leaflets oblong or cuneate-oblanceolate, 3 to 5 in number, 6 to 10 mm. long; umbels many-flowered; peduncles exceeding the leaves; bract (usually present) of 1 or 2 leaflets; flowers 8 to 10 mm. long; calyx teeth subulate, arising abruptly from the tube, recurved to nearly erect, lax, never stiffly erect as in *L. scoparius;* wings slightly longer than the keel; legumes falcate, 2-seeded, with subulate beak nearly as long as the body.

Extending along the coast from Sonoma County south to San Luis Obispo County. Distribution Map 8. April–October.

Localities.—Fort Ross, Sonoma County, *Heller* 6597 (calyx teeth short-triangular); south slope, Montara Mountains, San Mateo County, *Dudley*, March 17, 1900; Lighthouse Point near Pacific Grove, *Abrams* 5621, April 3, 1916 (type specimen for *Syrmatium abramsi* Noddin MS.); Pescadero Ranch, Monterey County, *Brewer* 671, "fine match for type of *Hosackia cytisoides* Benth." Jepson '06, Herb. Benth.; Point Pietras, *Greene*, June 10, 1887; Pacific Grove in pine woods, *Heller* 6816, distributed by Heller as *H. sylvestris*, "undoubted *Hosackia cytisoides*" Jepson '06, Herb. Benth.; Pacific Grove along the beach, *Heller* 6643; Seventeen-Mile Drive, Monterey, *I. McGuire* in 1917; Monterey, *Jepson*, August 8, 1896; Monterey, *Davy* 7223; Cypress Point, Monterey, *Eastwood* 74; sand dunes, Carmel, *Clemens* in 1919; near Carmel Bay, *Dudley*, April 4, 1894; back of dunes at Carmel, *Hall* 10065; Carmel, *Ottley* 1247, 1251, 1289; Carmel Hill, *Davy* 7525; Big Sur, *Davy* 7445; Little Sur, *Davy* 7873; Lucia, *Hall* 9984; near Gorda, *K. Brandegee*, June 11, 1909; San Simeon, *K. Brandegee*, June, 1888; Mill Creek, Santa Lucia Mountains, *Jepson* 2611; Santa Lucia Mountains, *Jepson* 1667, "good match for type" (*Hosackia cytisoides* Benth.), Jepson '06, Herb. Benth.; Big Creek, Santa Lucia Mountains, *K. Brandegee.*

References.—Lotus benthami Greene, Pitt., vol. 2, 1890, p. 148. *Hosackia cytisoides* Benth., Trans. Linn. Soc., vol. 17, 1837, p. 366, type from California, *Douglas.* *Syrmatium cytisoides* Greene, Bull. Calif. Acad., vol. 2, 1886, p. 147. *Hosackia cytisoides* var. *rubescens* Nutt. *in* T. and G. Fl., vol. 1, 1838, p. 324, type loc. near Santa Barbara.

24. **L. haydonii** Greene (pl. 78, figs. 1–6). Low thickly-branched perennials with leaves and flowers reduced in size and number until the plant seems to be little more than a mass of slender stiff green branches; few appressed hairs on the stem, somewhat more on the growing tips and calyces; leaves ternate, the tiny leaflets borne on a short petiole; leaflets elliptical, obtuse, 2.5 mm. long or less; flowers solitary or occasionally in pairs, slightly over 5 mm. long ("2 mm." according to Orcutt), borne on short peduncles; calyx one-half as long as the flower, with broadly linear teeth shorter than the tube; legume curved, 1-seeded, 5 mm. long; seed slightly curved.

Range exceedingly limited. Reported only from Mountain Springs and cañons in or near Colorado Desert, San Diego County. Distribution Map 8. April. Careful field observations of this species should be made to determine whether or not it intergrades with *L. scoparius.* The description given above is taken from Orcutt's type of *Hosackia haydoni*, but does not agree with Orcutt's diagnosis as to size of flower. Macbrides' diagnosis of *L. spencerae* does not differ essentially from the description above and his type is clearly conspecific with the specimens cited below.

Localities.—Colorado Desert cañons, *Orcutt*, April, 1889 (type of *Hosackia haydoni* Orcutt); stony desert slopes, Mountain Springs, Colorado Desert, *Spencer* 561 (type of *Lotus spencerae* Macbr.); Mountain Springs, San Diego County, *Valentien;* grade east of Mountain Springs, *L. M. Newlon* 369; Hansen's Ranch, Baja California, *Orcutt* (pod curved but not arcuate, resembling a short fruit of *L. scoparius*).

References.—LOTUS HAYDONI Greene, Pitt., vol. 2, 1890, p. 149. *Hosackia haydoni* Orcutt, West Am. Sci., vol. 6, 1889, p. 63, type loc., cañon leading into Colorado Desert, on the old stage line from San Diego to Fort Yuma. *Syrmatium haydoni* Heller, Muhl., vol. 9, 1913, p. 67. *Lotus spencerae* Macbride, Contrib. Gray Herb., n.s., vol. 53, 1918, p. 13, type loc., stony slopes, Mountain Springs, Colorado Desert, *Spencer*.

25. **L. junceus** Greene (pl. 78, figs. 7–14). Low brown much-branched suffrutescent perennials, suberect to decumbent; herbage sparsely covered with short appressed hairs, becoming glabrate with age; leaflets 3 to 5, rounded-oblanceolate, not over 6 mm. long; umbels few and peduncled; calyx teeth short-triangular, not at all subulate, the midvein broad and inconspicuous; legumes short, fat, and arcuate, 1 or 2-seeded.

Of infrequent occurrence on dry hills from Mt. Tamalpais southward near the coast to San Luis Obispo. Distribution Map 8. April–July. This species should not be confused with the form of *L. scoparius* appearing in San Diego County, which has triangular calyx teeth with a vein running through the center and ending in a subulate point. The aspect of *L. junceus* easily distinguishes it in the field from *L. scoparius* with which it is occasionally found growing.

Localities.—Mt. Tamalpais, *K. Brandegee*, May 2, 1905; Moraga Ridge, *Ottley* 777; Moraga Pass, *Davy* 1895; Kings Mountain road, San Mateo County, *Randall* 194; Big Basin, Santa Cruz County, *Pendleton* in 1908; Carmel road near Monterey, *Heller* 6826; San Luis Obispo, *Brewer* 475, "good match in technical characters for type of *Hosackia juncea* Benth. Type compact, broom-like, not so tall," Jepson '06, Kew Herb.

Var. **biolettii** Ottley n. comb. (pl. 78, figs. 15–22). More decumbent, the stems more delicate and often wiry; pubescence more abundant; peduncle usually exceeding the leaves and bearing a bract of one leaflet. Distinguishable from delicate plants of *L. benthamii* Greene by its terete arcuate fruit and its short-triangular calyx teeth.—North Coast Ranges from Marin County to Mendocino County. Distribution Map 8. May–July (October).

There is apparently no qualitative character to separate this variety from *L. junceus* Greene unless the manner of growth be considered as such. The length of the peduncle and the presence or absence of a bract can hardly be of specific value, as umbels with or without a bract may occur on the same plant, while the length of the peduncle is a variable character also. The pubescence is in kind that of the species, only more abundant, and the amount varies within the variety.

Localities.—Near Fort Bragg, *Davy* 6560; east of Fort Bragg, *Ottley* 1513; Fort Bragg to Glen Blair, *Eastwood* 1697; Point Arena, *Davy* and *Blasdale* 6021; Mt. Tamalpais, *T. S. Brandegee*, July 7, 1890; Mill Valley, *K. Brandegee* in 1913; Mill Valley, *Bioletti*, July, 1891; Mt. Tamalpais, *Michener* and *Bioletti*, May, 1893.

References.—LOTUS JUNCEUS Greene, Pitt., vol. 2, 1890, p. 148. *Hosackia juncea* Benth., Trans. Linn. Soc., vol. 17, 1837, p. 366, type

from California, *Douglas*. *Syrmatium junceum* Greene, Bull. Calif. Acad., vol. 2, 1886, p. 147. Var. BIOLETTII Ottley. *Lotus bioletti* Greene, Pitt., vol. 2, 1892, p. 222, type loc., dry ridges above Mill Valley, Marin County, *Bioletti*. *Syrmatium bioletti* Heller, Muhl., vol. 9, 1913, p. 67.

26. **L. eriophorus** Greene (pl. 79, figs. 1–9). Prostrate (ascending), much-branched, forming a dense mat several decimeters in diameter; herbage, calyces, and fruits covered with a dense villous pubescence, the hairs spreading out from the stem and giving the ends of the branches a woolly appearance; largest leaves on the main branches often conspicuously larger than the others, sometimes attaining a length of 2.5 cm.; leaflets 4 to 6, scattered, often one at the base of the leaf, oblanceolate or obovate, acute and apiculate; umbels 4 to 10-flowered; bract of one leaflet; peduncle very short to 5 mm. long; flowers 5 to 7 mm. long; calyx slightly more than one-half the length of the flower, with filiform teeth approaching the length of the tube; wings as long as or slightly longer than the keel; legumes fat, arcuate, with a long incurved beak, indistinctly keeled, usually 2-seeded.

Near the coast from Sonoma County south to San Diego County. Distribution Map 9. April–October.

Localities.—Bodega Point, Sonoma County, *Eastwood*, June 9, 1899; Bolinas Bay, Marin County, *Chesnut*, April, 1891; Italian Cemetery, San Francisco, *Bioletti*, June 22, 1892; south of life-saving station, San Francisco, *Jepson* 2633; Point Lobos, *Jepson*, August 20, 1891; Lands End, San Francisco, *Ottley* 119, 131, 415, 428, 1221; Big Trees, Santa Cruz County, *K. Brandegee* 16, 1889 (flower-length of the variety); Pacific Grove, in pine woods, *Heller* 6630; Pacific Grove, *Chandler* 346; Monterey, *State Survey* 635, "good match for type of *Hosackia tomentosa* Hook. & Arn. in Bentham Herb. Pubescence of type is slightly more brownish or rusty; leaflets of type are mainly like the largest ones on this." Jepson '06; Seventeen-Mile Drive, Monterey, *Noddin*, October 10, 1915; Point Carmel, *Setchell*, June 3, 1901; Carmel, *Ottley* 1256, 1304; San Simeon, *Curran*, June, 1888; Carlsbad, San Diego County, *Street* 1926 (pubescence of the variety); Mission Cañon near San Diego, *Hall* 3922; Palomar, *T. S. Brandegee*, August 1, 1898. The two specimens cited below although within the range of the variety possess the pubescence and flowers of the type: Red Hill near Upland, San Bernardino County, *Johnston*, May 6, 1917; Evey Cañon, *Johnston* 1913.

Var. **heermannii** Ottley n. comb. (pl. 79, figs. 10–17). Pubescence thinner, stems often glabrate; flowers smaller (3 to 5 mm. long); legumes mostly 1-seeded.—Within the range of the species from Santa Cruz County to San Diego County, extending eastward beyond the species into San Bernardino and Riverside counties. Distribution Map 9. April–November.

The typical varietal form appears at low altitudes in sandy washes near the coast. As it passes inland to the higher altitudes, as in the San Jacinto Mountains (Distribution Map 9), it approaches *L. douglasii* Greene var. *nevadensis* in general appearance, but may be distinguished from the latter by the spreading hairs of the young

stems. There is no technical character separating *L. heermannii* Greene from *L. eriophorus* Greene and the former, therefore, is considered by the writer but a variety of the latter, a variety with smaller flowers and less pubescence. It is not always possible to distinguish clearly between the species and the variety as occasionally small-flowered plants appear to have the pubescence of the species and large-flowered plants have the general aspect of the variety. The limit of 5 mm. for length of flower in the variety is arbitrarily chosen and holds true only in general.

Localities.—Soquel Creek, Santa Cruz County, *Dudley*, June 19, 1909; Soquel Cañon, *Jepson*, June 20, 1896; Santa Cruz Mountains, *Jepson*, June 19, 1896; Santa Margarita Valley, San Luis Obispo County, *Summers*, June 8, 1885; Coast Range north of San Luis Obispo, *Palmer* 81; Oxnard, Ventura County, *Davy* 7632; Tujunga Cañon, Los Angeles County, *Ottley* 692; Pocoima Cañon, *Hitchcock* 32; Arroyo Seco Cañon, Los Angeles County, *Geo. B. Grant*, June 17, 1904; Inglewood, Los Angeles County, *Abrams* 2486; Rivera, *Braunton* 330; Balloona, *Braunton*, 440; Balloona marshes, Los Angeles County, *Chandler* 2032; Santa Catalina Island, *Geo. B. Grant* 716; Campo, San Diego County., *T. S. Brandegee*, June 17, 1904; Fish Cañon, San Gabriel Mountains, *Ottley* 603, 612; San Gabriel River Cañon, *Abrams* 870, 2651; San Gabriel Wash, El Monte, *Ottley* 660; Claremont, *C. Baker*, August 2, 1903; Rock Creek, desert slope of San Gabriel Mountains, *Abrams* and *McGregor* 537; North Fork, Lytle Creek, San Antonio Mountains, *Peirson* 2283; North Fork, Lytle Creek, *Johnston* 1657; Lytle Creek, *Ottley* 712; Victorville, San Bernardino County, *Parish* 10577; Santa Ana River, *Parish* 11366; Mill Creek Cañon, San Bernardino Mountains, *Crawford* 943; vicinity of San Bernardino, *Parish* 4194; San Jacinto River, *Jepson* 1255; San Jacinto Valley, *Reinhardt*, June, 1897; Whitewater, *Parish*, 208; Temescal Cañon, Riverside County, *Munz* 2124 (flowers slightly over 5 mm. long); West Cañon, Palm Springs, *Copeland*, May, 1904; Palm Cañon, *F. M. Reed* 3874; Palm Cañon to Vandeventer's, *Jepson* 1362; Coyote Cañon, Colorado Desert, *Hall* 2825; Nuevo-Ramona, *T. S. Brandegee*, May 19, 1894; Cuyamaca, *K. Brandegee*, July 16, 1906; Jamuel Valley, San Diego County, *Palmer* 59; San Diego, *K. Brandegee*, June 5, 1894; Granite, vicinity of San Diego, *Spencer* 93; Jacumba, *Munz* 1671; Tia Juana, *Abrams* 3505. Specimens suggesting *L. douglasii* Greene var. *nevadensis:* In open pine forests in vicinity of Strawberry Valley (alt. 5200–6000 ft.), San Jacinto Mountains, *Hall* 2379; Strawberry Valley, San Jacinto Mountains, *Geo. B. Grant*, August, 1901; Strawberry Valley, San Jacinto Mountains, *Jepson* 2287; Shingle Valley, in partially exposed places (alt. 4400 ft.), *Hall* 2022B and 2022A; San Jacinto Mountains, south side in shade, chaparral belt (alt. 4000 ft.), *Hall* 2021; San Jacinto Mountains (alt. 6000 ft.), *Hall* in 1897.

References.—LOTUS ERIOPHORUS Greene, Erythea, vol. 1, 1893, p. 207. *Syrmatium eriophorum* Heller, Muhl., vol. 9, 1913, p. 67. *Hosackia tomentosa* Hook. & Arn., Bot. Beech., 1832, p. 137, type from California. *Syrmatium tomentosum* Vogel, Linnaea, vol. 10, 1836, p. 591. *Lotus tomentosus* Greene, Pitt., vol. 2, 1890, p. 150. Var. HEERMANNII Ottley. *Hosackia heermannii* Dur. & Hilg. *in* Jour.

Acad. Phila., ser. 2, vol. 3, 1854, p. 39, type loc., Tejon Pass, *Heermann. H. heermanni* Dur. & Hilg., Pac. R.R. Rep., vol. 5, part 3, 1855, p. 6, pl. 4. *Syrmatium heermanni* Greene, Bull. Calif. Acad., vol. 2, 1886, p. 148. *Lotus heermanni* Greene, Pitt., vol. 2, 1890, p. 150.

27. **L. douglasii** Greene (pl. 80, figs. 1–8). Perennials with long (4 dm.) decumbent branches, long internodes, and peduncled umbels extending along the stems; stems clothed with short appressed hairs; leaves and calyces with a somewhat looser pubescence; largest leaves 2 to 3 cm. long; leaflets 4 or 5, oblanceolate or obovate, usually acute; umbels several-flowered, the bract when present of one or more leaflets; flowers 10 to 12 mm. long; calyx teeth linear-subulate, villous, equal in length to the tube; blade of the banner oblong, wings oblong, noticeably surpassing the keel; legumes arcuate, extending well beyond the calyx, canescent, keeled, and attenuately beaked.

Northern California north to Washington and Idaho. Sonoran and Transition. Distribution Map 9. May–July. Reaches its typical condition in the states north of California. In northern California it becomes somewhat reduced, with leaves less than 2 cm. long, flowers 8 to 12 mm. long, and calyx teeth equal in length to the tube or shorter. In Humboldt, Siskiyou, Trinity, and Lake counties it passes into the variety *congestus;* in the northern Sierra Nevada, into the variety *nevadensis* (Distribution Map 9).

Localities.—Washington: West Klickitat County, *Suksdorf*, June 16, 1883; between Olympia and Gate City, *Heller* and *Heller* 4047. Idaho: Coeur d'Alene Indian Reservation, *Heller* 551 (Sandberg Exped.), "very near type of *Hosackia decumbens* Benth." Jepson '06, Kew Herb. Oregon: sandy, stony forest of Black Butte, *Cusick* 2679; dry gravelly prairies, Hood River, *Henderson*, flowers June 21, fruits September 6, 1896; Badger Creek, *Wilson*, July, 1893. California: Scott River Valley, *Gilbert*, June–July, 1899; near Yreka, *Butler* 777; dry banks near Yreka, *Butler* 1441; Yreka, Siskiyou County, *Heller* 8000; Sisson, *K. Brandegee*, July, 1887; Goose Valley, Shasta County, *Baker* and *Nutting*, May 26, 1894; lava beds, northeastern Shasta County, *Hall* and *Babcock* 4238; rocky ridge of Big Valley, Lassen County, *M. S. Baker*, July 3, 1893; Susanville, *T. S. Brandegee*, July 2, 1892; Sierra County, *Lemmon* 59 in 1875 (approaches var. *nevadensis*).

Var. **nevadensis** Ottley n. comb. (pl. 80, figs. 9–16). Perennials (flowering the first season), prostrate, with wiry branches; pubescence always appressed; leaves 1 to 1.5 cm. long; peduncles shorter than in the species; flowers 4 to 7 mm. long; calyx teeth typically not more than half the length of the tube; wings equaling or exceeding the keel in length; keel not beaked, the upper margin almost a straight line.

Occurring sparingly in northern California but abundant in the Transition of the Sierra Nevada, and of occasional occurrence in the mountains of southern California. Also in Nevada. Distribution Map 9. May–August. In southern California its place is largely taken by *L. davidsonii* Greene and *L. argophyllus* Greene var. *decorus*. In the San Jacinto Mountains it is scarcely distinguishable from *L. eriophorus* Greene var. *heermannii*. It appears in San Diego County, though hardly in its typical condition.

Localities.—Dietz Station near Black Butte, Siskiyou County, *Heller* 11711; Upton, Siskiyou County, *Jepson;* Lassen Peak, Plumas County, *Austin* 460; grade between Genessee Valley and Summit, Plumas County, *Heller* and *Kennedy* 8865; Butte Meadows, Butte County, *Heller* 12828; Bear Valley, Nevada County, *Jepson*, July, 1898; Boca, *Curran* in 1885; Summit—Soda Springs, *Kennedy* and *Doten* 249; south of Donner Lake, *Heller* 6950; meadow along Truckee River, *Sonne* 64; about Lake Tahoe, *Geo. B. Grant* 6980; Emerald Bay, El Dorado County, *Ottley* 1188; Cascade Lake, *Ottley* 1195; near Myers, *Ottley* 959, 976; Wiley's, Amador County, *K. Brandegee,* July 1886; Lake Merced, Merced River, *Jepson* 3196 (erect, 15 cm. high, with many branches); Calaveras Big Trees, *Dudley* in 1906; Kennedy Meadow, Tuolumne County, *A. L. Grant* 916; Crocker's, Mariposa County, *Blasdale*, May 22, 1895; Camp Awahnee, Yosemite Valley, *Hall* 9150; Alder Creek Trail, Yosemite Park, *Jepson* 4322; Hazel Green to Big Meadows, Coulterville trail to Yosemite, *Jepson*, July 6, 1896; Pine Ridge, Fresno County, *Hall* and *Chandler* 174; Kings River Cañon, *Jepson*, 774; Kings River Cañon, *Ottley* 1492; Granite Creek, Fresno County, *Coville* and *Funston* 1838; Old Colony Mill, *K. Brandegee*, July 27, 1905; North Fork, Kaweah River, *Dudley* 1400; South Fork, Kaweah River, *Culbertson* 4514; head of Kern River, Soda Creek, *Dudley* 1959; Kern River, Tulare County, *Dudley* 667; Middle Tule River, *Purpus* in 1885; Cannell Meadows, Tulare County, *Hall* and *Babcock* 5123; Greenhorn Range, Kern County, *Hall* and *Babcock* 5061 (not typical, many of the leaves over 2 cm. long, peduncles long as in the species); Eaton Cañon, San Gabriel Mountains, *Ottley* 540; Strawberry Valley, San Jacinto Mountains, *Jepson* 2287, 2288; vicinity of Deer Springs, San Jacinto Mountains, *Hall* 2337; between Julian and Cuyamaca, San Diego County, *Abrams* 3963. In the following plants the pubescence suggests that of *L. davidsonii*, but the flowers resemble those of the variety under consideration: San Jacinto River Cañon, growing in the river sand, *Street* and *Durant*, May 12, 1918; Cuyamaca, *T. S. Brandegee*, July 7, 1894; Cuyamaca Peak (alt. 4000 ft.), *Reed*, June 29, 1897; Laguna, San Diego County, *Cleveland* 408, July 6, 1885; Laguna, *Mearns* 3524.

Var. **congestus** Ottley n. nom. Branches shorter than in the species, 15 to 20 cm. long; internodes short; umbels dense and confined to the ends of the branches; villous pubescence more marked; leaflets elliptical, acute at both ends.—Appearing in some of the northwestern counties of the state, in the Sonoran. Distribution Map 9. May–July. Specimen from Crook County, Oregon, *Ferris* and *Duthie* 565, tends toward this variety in general aspect.

Localities.—Tunis Mill, Lake County, *T. S. Brandegee;* Snow Mountain, Lake County, *T. S. Brandegee*, June 24; Mt. Sanhedrin, Lake County, *Hall* 9523; Mt. Sanhedrin, *Heller* 5916; mountain slopes along road between Three Creeks and mouth of Willow Creek, Humboldt County, *Tracy* 3358; Three Creeks to Willow Creek, *Jepson* 1979 (*Lotus incanus* Dougl. according to Jepson '06, Kew Herb.); northwest slope of Buck Mountain, Humboldt County, *Tracy* 2913; Pilot Ridge, Humboldt County, *Chesnut* and *Drew*, July 19, 1888; a duplicate (does not have the umbels dense or congested at the ends

of the branches); Klamath River, Humboldt County, *Chandler* 1487; north of Weaverville, Trinity County, *Yates* 300; Siskiyou County, *Rattan* in 1879.

References.—Lotus douglasii Greene, Pitt., vol. 2, 1890, p. 149. *Hosackia decumbens* Benth. *in* Lindl. Bot. Reg., vol. 15, 1829, under t. 1257, type from northwest coast of America, *Douglas.* Var. nevadensis Ottley. *Hosackia decumbens* var. *(?)nevadensis* Wats., Bot. Calif., vol. 1, 1876, p. 138. According to Watson, *loc. cit.*, *H. heermannii* of Anderson, Cat. Nev. Fl., 1870(?), p. 119 and *H. heermannii*, in part, of Wats. Bot. King. vol. 5, 1871, p. 63. *Syrmatium nevadense* Greene, Bull. Calif. Acad., vol. 2, 1886, p. 148. *Lotus nevadensis* Greene, Pitt., vol. 2, 1890, p. 149. *Hosackia nevadensis* Parish, Plant World, vol. 20, 1917, p. 220. Var. congestus Ottley. *Lotus incanus* Dougl., MSS *in* Hook., Fl. Bor. Am., vol. 1, 1833, p. 134.

28. **L. argophyllus** Greene (pl. 81, figs. 1–8). Silvery-canescent suffrutescent perennials, with a close tomentum, usually extending from tip to base of the long slender decumbent branches; pubescence of leaves and calyces longer, denser, and more silky; leaves 8 to 15 mm. long, with the 3 to 5 roundish obovate leaflets borne close to the stems; the dense, nearly sessile (as a rule) umbels reaching back along the branches for some distance; bract of one leaflet usually present; pedicels short, hidden by the pubescence; flowers 8 to 10 mm. long; calyx teeth filiform, about one-half the length of the tube, obscured by the hairs; claws of petals not exserted beyond calyx tube, relative lengths of claws and blades variable (the short blades and long claws figured by Miss Eastwood for this species in contrast with her proposed species, *Hosackia venusta*, are found not to be the typical condition); ovary with 2 to 4 ovules, in fruit keeled (as a rule), attenuately beaked, short, extending but a slight distance beyond the calyx and containing but one seed; seeds mottled, smooth, curved-oblong.

A highly variable species extending south and east from Monterey County in the Lower and Upper Sonoran. March–July. Varieties occur in the Sierra Nevada, in the mountains of southern California, and on the islands west of the state and of Lower California. Distribution Map 10. When the type approaches *L. davidsonii* Greene in appearance it may be distinguished from the latter by the straight hairs on the leaves and calyces.

Localities.—Limekiln Creek, Monterey County, *Hall* 10000 (petal claws long); Point Sur, *T. S. Brandegee*, July, 1888; Big Sur, *Davy* 7429; Ventana Cone, Little Sur, *Davy* 7388; near Cahuenga Pass, Los Angeles County, *pupils of Los Angeles High School*, June, 1904 (leaves and inflorescence resembling those of var. *ornithopus*); Warner's Springs, *A. L. Combs;* Witch Creek, *Alderson*, April, 1894; Ramona, *T. S. Brandegee*, April 3, 1894; Julian, *T. S. Brandegee*, June 14, 1894; near Foster, *Hall* 3884; near Campo, *Abrams* 3604; Descanso, *Eastwood* 9083; San Diego, *Cleveland;* Cuyamaca, *T. S. Brandegee*, June 3, 1896; vicinity of San Diego, *Spencer* 89; Winchester, Riverside County, *Hall* 423; vicinity of Sage, Riverside County, *Hall* 2899; El Toro Mountain, San Jacinto Mountains, *Hall* 1169 (calyx teeth long); Box Springs Mountain, *Zumbro*, April 10, 1902; San Bernardino, *Parish Bros.* 403; Erskine Creek, *Purpus*

5052; part of Kellogg's type of Hosackia argentea; Kaweah River, eighteen miles east of Visalia, *Woolsey*, March 20, 1898; Hot Springs, *Eastwood* 2617; Bear Creek, Tulare County, *Purpus* 1741; Toll House, Fresno County, *Hall* and *Chandler* 46.

Var. **fremontii** Ottley n. comb. (pl. 81, figs. 9–14). Umbels dense and confined to the ends of the branches, giving them a top-heavy appearance; calyx teeth filiform, as long as the tube and obscured by the dense matted hairs; blade of banner shorter than its claw; leaves slightly longer than those of the species, leaflets broadly oblanceolate or obovate to elliptical, acute.—Sierra Nevada from Placer County to Mariposa County. Also possibly occurring in the Santa Lucia Mountains on the western coast. May–July.

Localities.—Hite's Cove road, Mariposa County, *Congdon*, May 29, 1898; Yosemite Valley, *Chesnut* and *Drew*, July 16, 1889; Yosemite, *Parry;* Sweetwater Creek, El Dorado County, *Simpson*, June, 1907; ridge above Bear Valley, Placer County, *Jones;* Newcastle, *Mackie*, April–May, 1904; Colfax, *Jones* 3338; Cape Horn, *Essig*, June 17, 1916 ("erect, bushy"); Cape Horn, *J. P. Moore;* Santa Lucia Mountains, *Jepson* 1654.

Var. **decorus** Ottley n. comb. (pl. 81, figs. 15–22). Herbage glistening satiny-canescent throughout or at tips of branches only; plants prostrate, forming dense mats covered with the yellow flowers which turn pinkish purple with age; banner blade oblong, longer than the claw; umbels peduncled and pedicels more evident than in the species. Mostly in the Upper Sonoran of the mountains of southern California. April–July.

Localities.—Little Tujunga Wash, Los Angeles County, *Ottley* 565; Tujunga Cañon, *Ottley* 697; Mt. Lowe, *Geo. B. Grant*, May 23, 1901; Old Wilson Trail, *Geo. B. Grant*, April 1, 1898; Old Wilson Trail, *Brown* in 1894; Mt. Wilson, *Ottley* 655; Little Santa Anita Cañon, *Geo. B. Grant*, May 27, 1902; Evey Cañon, *Johnston*, May 6, 1917; *Day* Cañon, San Antonio Mountains, *Johnston* 1737; Cascade Cañon, San Antonio Mountains, *Johnston* 1278 (type of *Hosackia argophylla* var. *decora* Johnston); mouth of Cucamonga Cañon, San Antonio Mountains, *Johnston* 27H; Lytle Creek, San Antonio Mountains, *Ottley* 701; Bear Cañon, tributary San Antonio River, *Peirson*, May 28, 1920; vicinity of San Bernardino, *Parish* 4389; San Bernardino, *Parish Bros.*, June, 1884; Glen Martain, San Bernardino Mountains, *Crawford* 922; Waterman Cañon, *Parish* 11392; Devil's Cañon, San Bernardino Mountains, *Munz*, 2789; Dark Cañon road, San Bernardino Mountains, *Munz, Street* and *Williams* 2802; southern slope of San Bernardino Mountains, *Parish* 7115; San Bernardino Mountains, *Parish Bros.*, June, 1888.

Var. **niveus** Ottley n. comb. (pl. 82, figs. 1–11). Stems woody and stocky, characterized by short internodes and raised leaf scars at base, otherwise much as in variety *fremontii.*—Santa Cruz and San Clemente islands.

Localities.—Santa Cruz Island, *Greene* in 1886; Santa Cruz Island, *T. S. Brandegee* in 1888; San Clemente Island, *T. S. Brandegee*, August 25, 1894.

Var. **ornithopus** Ottley n. comb. (pl. 82, figs. 12 and 13). Erect (according to Greene), less pubescent than the others, the herbage somewhat silky, the stem becoming glabrate; leaves 7 mm. to 1.9 cm. long; leaflets mostly 4 or 5 (3 to 7), 6 to 12 mm. long, oblanceolate to oblong, acute; umbels long-peduncled, extending along the branches; legumes conspicuously exserted beyond the calyx and curved upward, 2-seeded, otherwise much as var. *fremontii*.—Islands off the coast of southern California. April–June.

Localities.—Guadalupe Island, Greene in 1885 (type of *Hosackia ornithopus*); Guadalupe Island, *Palmer* 853; Santa Catalina Island, *Cox*, March 31, 1908; *Davidson* 5; *Jepson* 3066; *Condit* 12; *Grant* and *Wheeler*, April 21–26, 1904; *K. Brandegee*, May, 1889; *Trask*, May, 1896; San Nicholas Island, *Trask*, April, 1897 (type of Eastwood's *Hosackia venusta*); Santa Barbara Island, *Trask*.

References.—Lotus argophyllus Greene, Pitt., vol. 2, 1890, p. 149. *Hosackia argophylla* Gray, Mem. Am. Acad. n.s., vol. 5, 1854, p. 316, type loc., San Isabel, May, 1852. *Syrmatium argophyllum Greene*, Bull. Calif. Acad., vol. 2, 1886, p. 147. *Hosackia argentea Kellogg*, Proc. Calif. Acad., vol. 3, 1863, p. 38, pl. 8, type loc., Kern River, *Hutchings*. Var. fremontii Ottley. *Hosackia argophylla* var. *? fremonti* Gray, Proc. Acad. Phila., vol. 15, 1863, p. 347. *Lotus fremonti* Heller, Cat. N. Am. Pl., ed. 2, 1900, p. 7. *Syrmatium fremontii* Heller, Muhl., vol. 9, 1913, p. 67. Var. decorus Ottley. *Hosackia argophylla* var. *decora* Johnston, Bull. S. Calif. Acad., vol. 17, part 2, 1918, p. 63, type loc., Cascade Cañon, Fork of San Antonio Cañon. Var. niveus Ottley. *Syrmatium niveum* Greene, Bull. Calif. Acad., vol. 2, 1886, p. 148, type loc., Santa Cruz Island, *Greene*. *Lotus niveus* Greene, Pitt., vol. 2, 1890, p. 148. Var. ornithopus Ottley. *Hosackia ornithopus* Greene, Bull. Calif. Acad., vol. 1, 1885, p. 185, type loc. Guadalupe Island. *Syrmatium ornithopum* Greene, Bull. Calif. Acad., vol. 2, 1886, p. 148. *Lotus ornithopus* Greene, Pitt., vol. 2, 1890, p. 149. *Hosackia venusta* Eastwood, Proc. Calif. Acad., ser. 3, vol. 1, 1898, p. 103, pl. 8, type loc., San Nicholas Island, *Trask*. *Lotus venustus* Heller, Cat. N. A. Pl., ed. 2, 1900, p. 7.

29. **L. davidsonii** Greene (pl. 82, figs. 14–21). A species closely resembling *L. douglasii* Greene var. *nevadensis* on the one side and *L. argophyllus* Greene var. *decorus* on the other, but always differing from either in the character of its corolla. Herbage either silvery or bluish-green; flowers 5 to 8 mm. long; calyx teeth linear-subulate, one-half as long as the tube or approaching it in length; the short obovate banner blade erect, making a right angle with the wings, or reflexed; keel slightly angled on its upper surface.

Pine belt of the mountains of southern California. Distribution Map 10. May–August.

Localities.—Griffins, Mt. Pinos, *Elmer* 3977; Mt. Pinos, North Creek (alt. 6700 ft.), Ventura County, *Hall* 6537; Mt. Gleason Summit, southern California, *Barber* 260; Mt. Wilson, *Davidson*, August, 1892 (type of *Lotus sulphureus* Greene); Mt. Wilson, *Geo. B. Grant*, June 16, 1906 and June 10, 1907; Mt. Wilson, *Abrams* 1880; Sierra Madre trail, Mt. Wilson, *Abrams* 2604; Kelly's cabin, Ontario Peak, San Antonio Mountains, *Johnston* 1552; Baldy Lookout, *Johnston*

1258; south slope of Baldy, San Antonio Mountains, *Johnston* 1423; head of South Fork, Lytle Creek, San Antonio Mountains, *Johnston* 1458; San Antonio Mountains, *Hall* 289; Ontario Ridge, *Peirson* 96; Swartout Cañon, San Antonio Mountains, *Hall* 1253, 1519; Glen Martain, San Bernardino Mountains, *Smith* 14; above Seven Oaks, *Crawford* 936; Dry Lake (alt. 9100 ft.), *Hall* 7612; Bear Valley, *Hall*, July, 1899; between Bear Valley and Bluff Lake, *Hall*, June 28, 1899; Little Green Valley, *Geo. Hall* 33; Fredalba, San Bernardino Mountains, *Munz* and *Johnston* 2898; Bear Valley, *Edwards*, June 1, 1916; Little Bear Valley, *Parish* 1406; Pine Crest, San Bernardino Mountains, *Munz, Street* and *Williams* 2814.

References.—Lotus davidsonii Greene, Erythea, vol. 1, 1893, p. 207. *L. sulphureus* Greene, Pitt., vol. 2, 1892, p. 293, type loc., Wilson's Peak, Los Angeles County, *Davidson*. *Syrmatium davidsonii* Heller, Muhl., vol. 9, 1913, p. 67.

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EXPLANATION OF PLATES

PLATE 61

L. incanus Greene

Fig. 1. Habit. × 1.
Fig. 2. Cluster of fruits. × 1.
Fig. 3. Flower. × 4.
Figs. 4–8. Dissected flower. × 4.

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PLATE 62

L. stipularis Greene

Fig. 1. Habit. × 1.
Fig. 2. Flower. × 4.
Figs. 3–7. Dissected flower. × 4.
Fig. 8. Seed. × 4.

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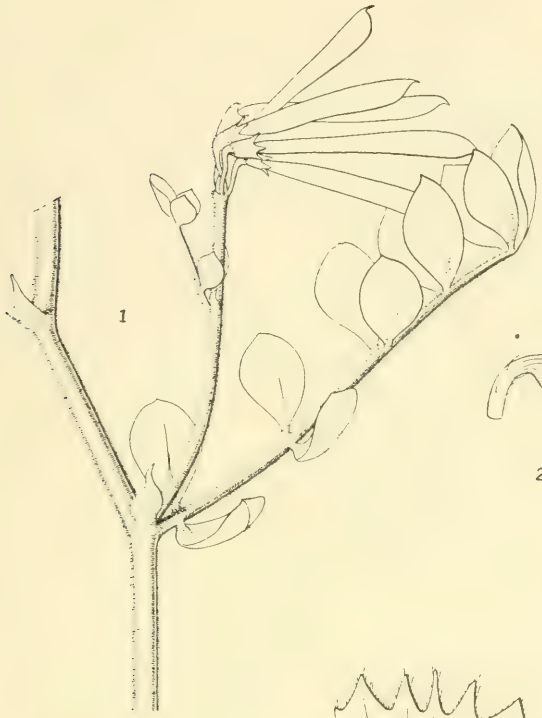
PLATE 63

L. stipularis Greene

Fig. 1. Cluster of fruits. × 1.

L. stipularis Greene var. *subglaber*

Fig. 2. Flower. × 4.
Figs. 3–7. Dissected flower. × 4.
Fig. 8. Seeds. × 4.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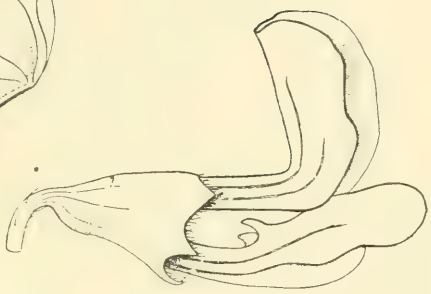
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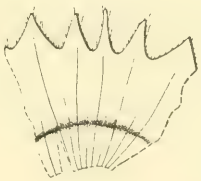
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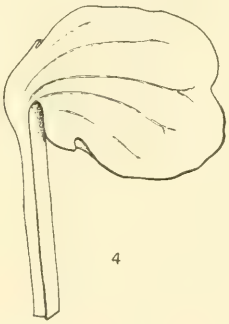
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PLATE 64

L. crassifolius Greene

Fig. 1. Habit. × 1.
Fig. 2. Flower. × 4.
Figs. 3–5. Dissected corolla. × 4.

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PLATE 65

L. crassifolius Greene

Fig. 1. Cluster of fruits. × 1.
Fig. 2. Calyx showing calyx teeth slightly larger than the typical condition. × 4.
Fig. 3. Calyx with the short-subulate teeth. × 4.
Fig. 4. Pistil. × 4.
Fig. 5. Seed. × 4.

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PLATE 66

L. pinnatus Hook.

Fig. 1. Flower. × 4.
Figs. 2–6. Dissected flower. × 4.

L. formosissimus Greene

Fig. 7. Flower. × 4.
Figs. 8–12. Dissected flower. × 4.
Fig. 13. Seed. × 4.

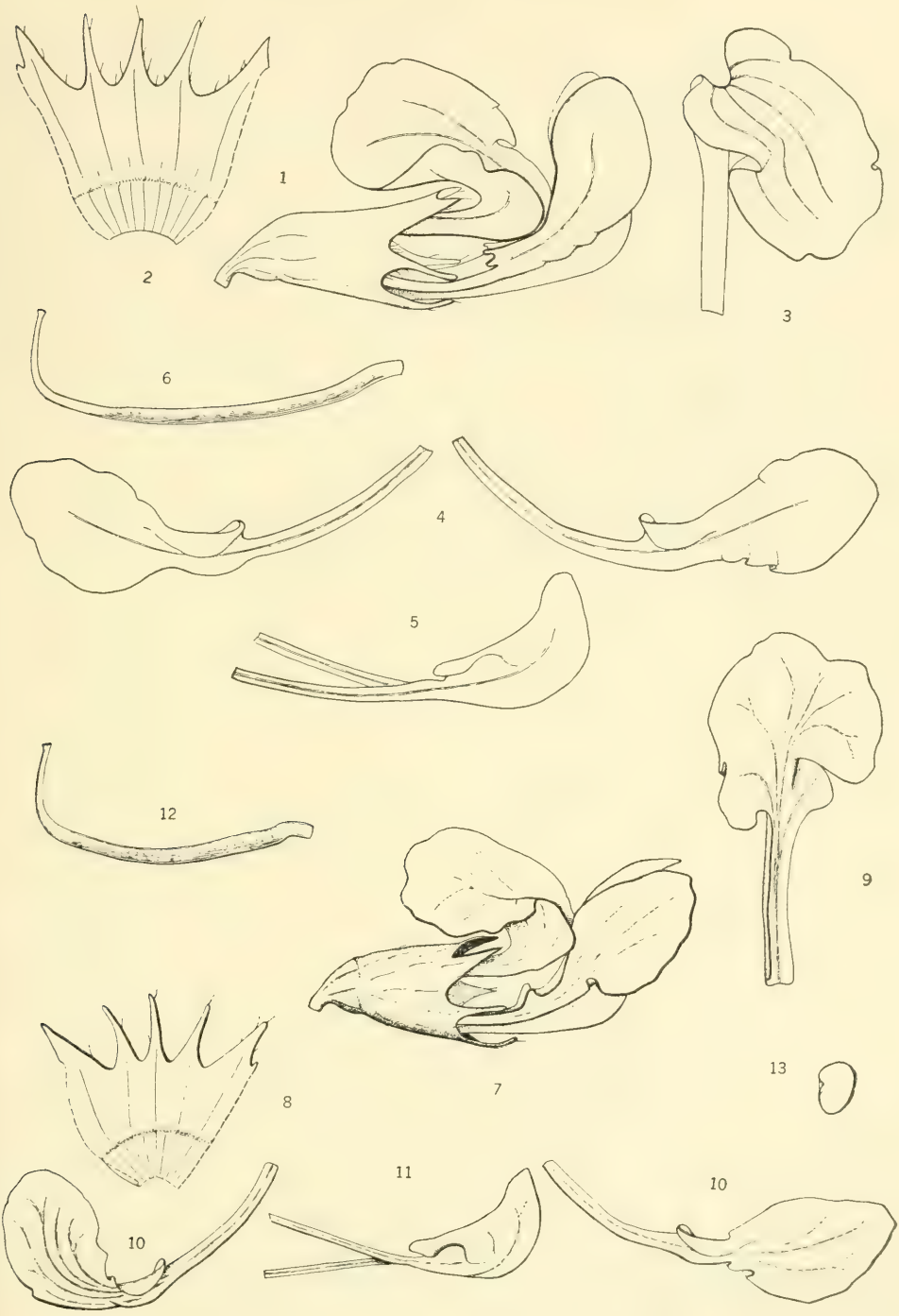
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PLATE 67

L. oblongifolius Greene var. *torreyi*

Fig. 1. Flower. × 4.
Figs. 2–6. Dissected flower. × 4.
Fig. 7. Seed. × 4.

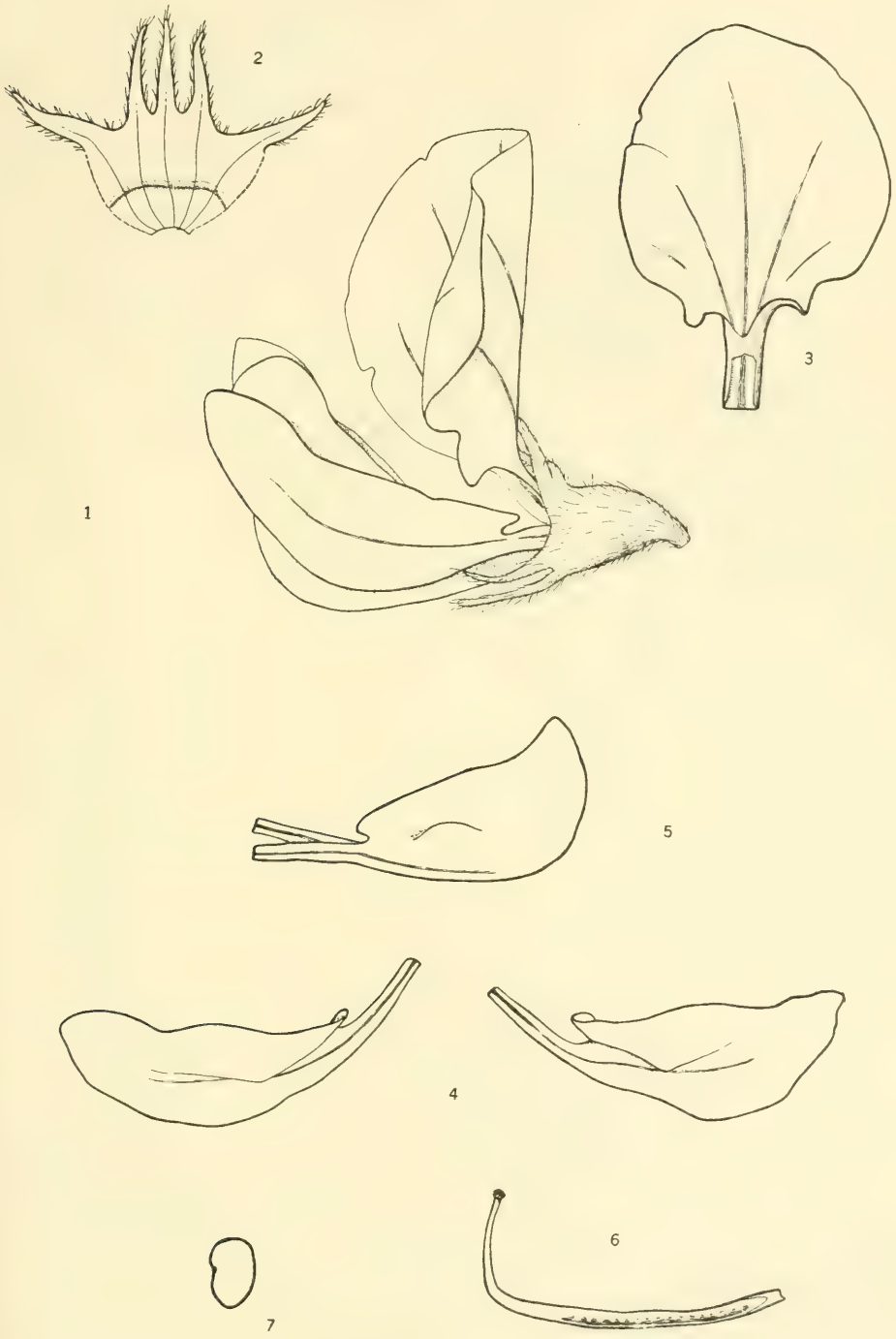
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PLATE 68

L. grandiflorus Greene

Fig. 1. Habit. × 1.

L. grandiflorus Greene var. *mutabilis*

Fig. 2. Flower. × 4.
Figs. 3–5. Dissected corolla. × 4.
Fig. 6. Pistil. × 4.

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PLATE 69

L. grandiflorus Greene var. *mutabilis*

Fig. 1. Calyx. × 4.

L. rigidus Greene

Fig. 2. Flower. × 4.
Figs. 3–7. Dissected flower. × 4.
Fig. 8. Seed. × 4.

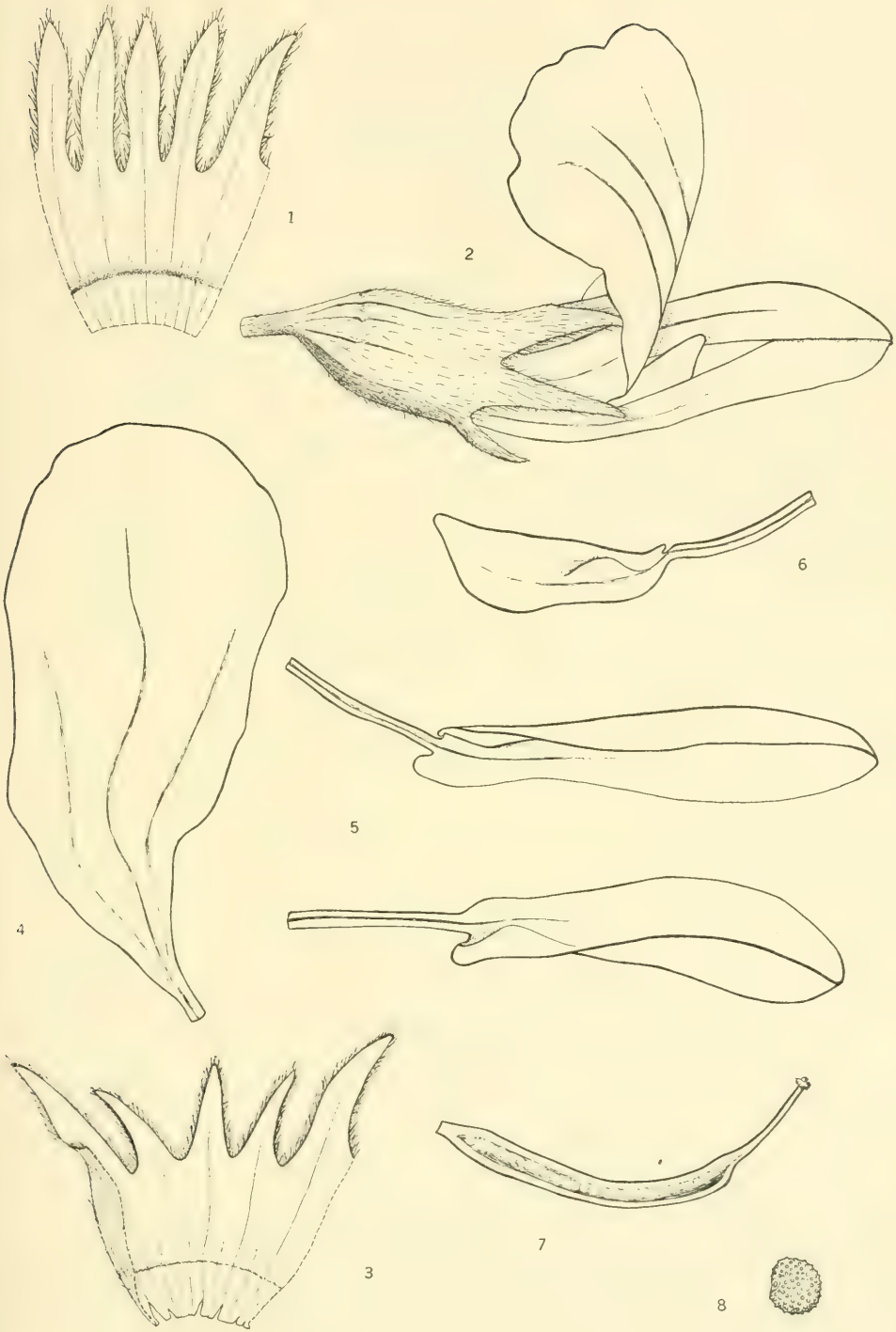
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PLATE 70

L. wrightii Greene

Fig. 1. Flower. × 4.
Figs. 2–6. Dissected flower. × 4.

L. wrightii Greene var. *multicaulis*

Fig. 7. Flower. × 4.
Figs. 8–12. Dissected flower. × 4.
Fig. 13. Seed. × 4.

L. argyracus Greene

Fig. 14. Flower. × 4.
Figs. 15–19. Dissected flower. × 4.
Fig. 20. Fruit. × 4.
Fig. 21. Seed from same plant as fig. 20 (collection Parish 3097).
Fig. 22. Seed from another plant (collection Hall 2140).

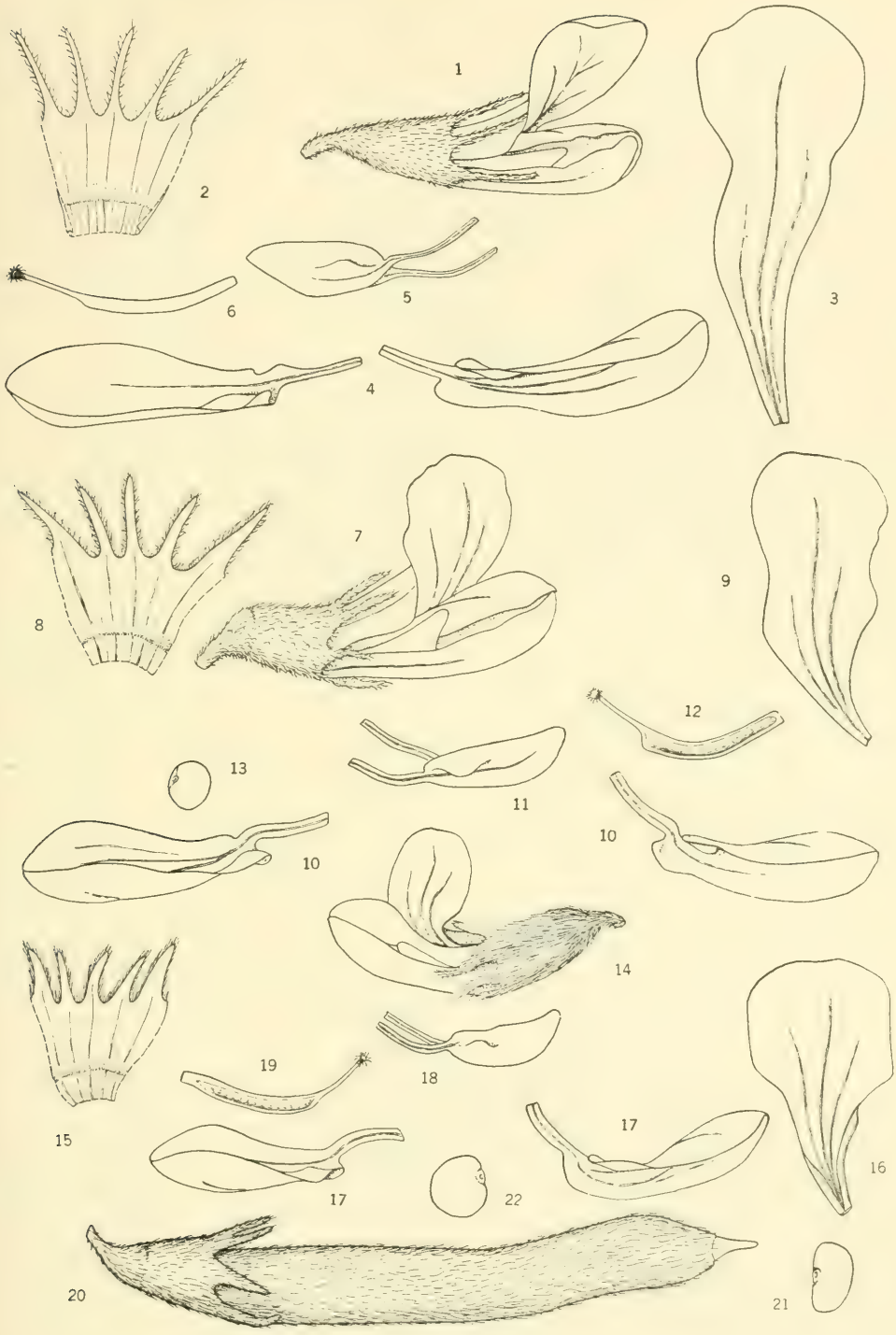
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PLATE 71

L. strigosus Greene

Fig. 1. Flower of the large-flowered form. × 4.
Figs. 2–6. Dissected flower. × 4.
Fig. 7. Flower of the small-flowered form. × 4.
Fig. 8. Surface view of seed of small-flowered form. × 4.
Fig. 9. Cross-section of seed of small-flowered form. × 4.
Fig. 10. Surface view of seed of small-flowered form. × 4.
Fig. 11. Cross-section of seed of small-flowered form. × 4.
Fig. 12. Side and end views of seed of *L. strigosus* Greene var. *hirtellus*. × 4.

L. tomentellus Greene

Fig. 13. Habit. × 1.
Fig. 14. Flower. × 4.
Figs. 15–19. Dissected flower. × 4.
Fig. 20. Seed. × 4.

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PLATE 72

L. salsuginosus Greene

Fig. 1. Habit. × 1.
Figs. 2–6. Dissected flower. × 4.
Fig. 7. Seed. × 4.

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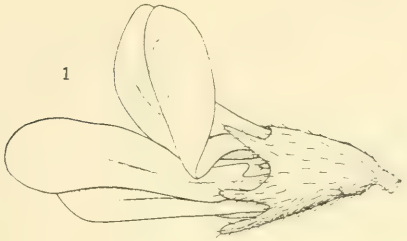
PLATE 73

L. salsuginosus Greene

Fig. 1. Flower. × 4.
L. salsuginosus Greene var. *brevivexillus*
Fig. 2. Flower. × 4.
Figs. 3–7. Dissected flower. × 4.
Fig. 8. Fruit. × 4.
Fig. 9. Seed. × 4.

L. micranthus Benth.

Fig. 10. Flower. × 4.
Figs. 11–15. Dissected flower. × 4.
Fig. 16. Seeds. × 4.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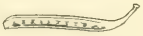
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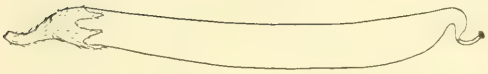
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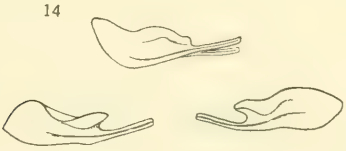
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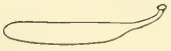
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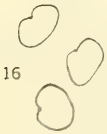
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PLATE 74

L. americanus Bisch.

Fig. 1. Flower. × 4.
Figs. 2–6. Dissected flower. × 4.
Fig. 7. Seed. × 4.

L. denticulatus Greene

Fig. 8. Flower. × 4.
Figs. 9–13. Dissected flower. × 4.
Fig. 14. Seed. × 4.

L. subpinnatus Lag.

Fig. 15. Flower. × 4.
Figs. 16–19. Dissected flower (banner omitted). × 4.
Fig. 20. Seeds. × 4.

L. humistratus Greene

Fig. 21. Flower. × 4.
Figs. 22–26. Dissected flower. × 4.
Fig. 27. Seeds. × 4.

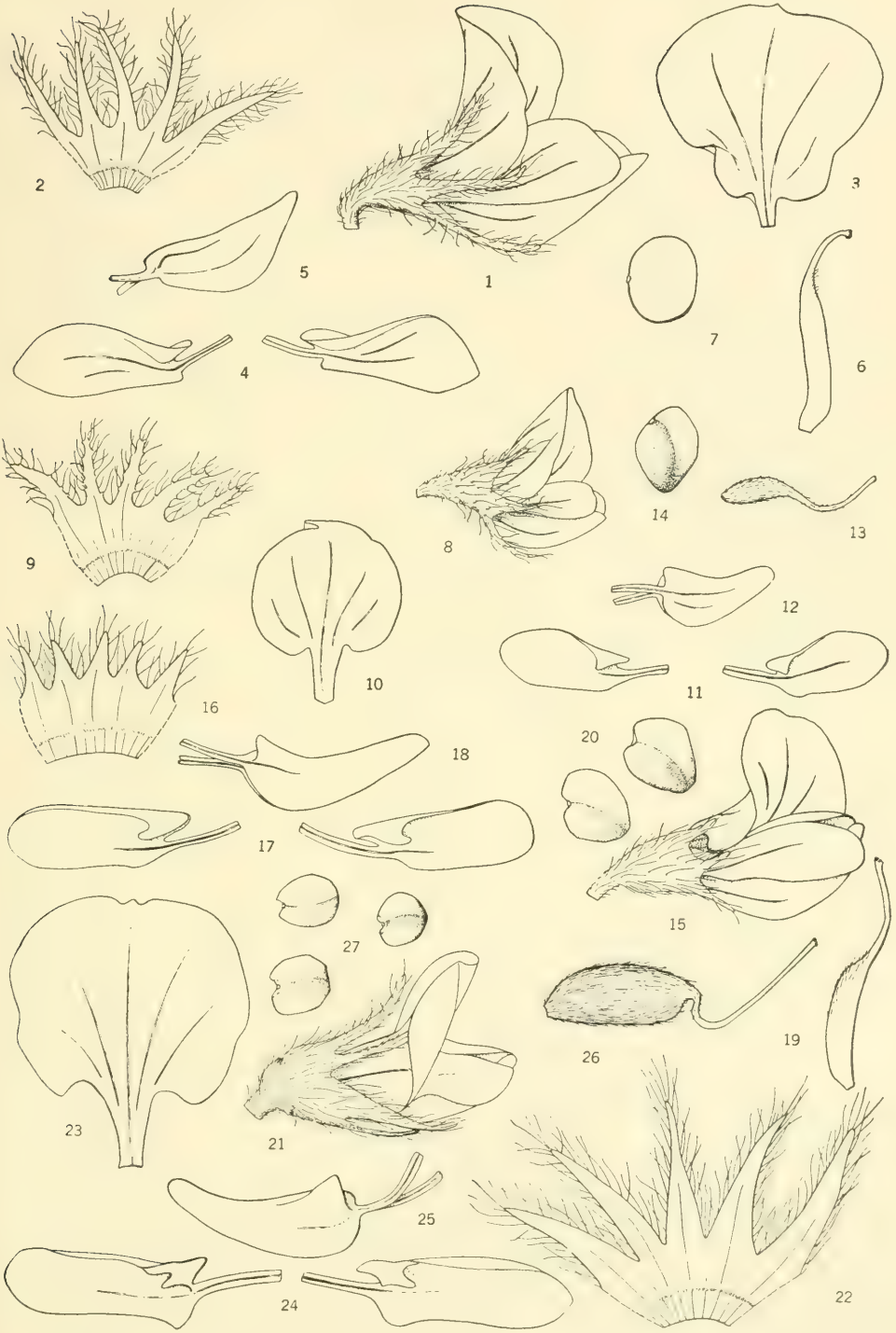
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PLATE 75

L. nuttallianus Greene

Fig. 1. Flower. × 4.
Figs. 2–6. Dissected flower. × 4.
Fig. 7. Fruit. × 4.
Fig. 8. Seed. × 4.

L. hamatus Greene

Fig. 9. Habit. × 1.
Fig. 10. Flower. × 4.
Figs. 11–15. Dissected flower. × 4.
Fig. 16. Fruit. × 4.
Fig. 17. Seeds. × 4.

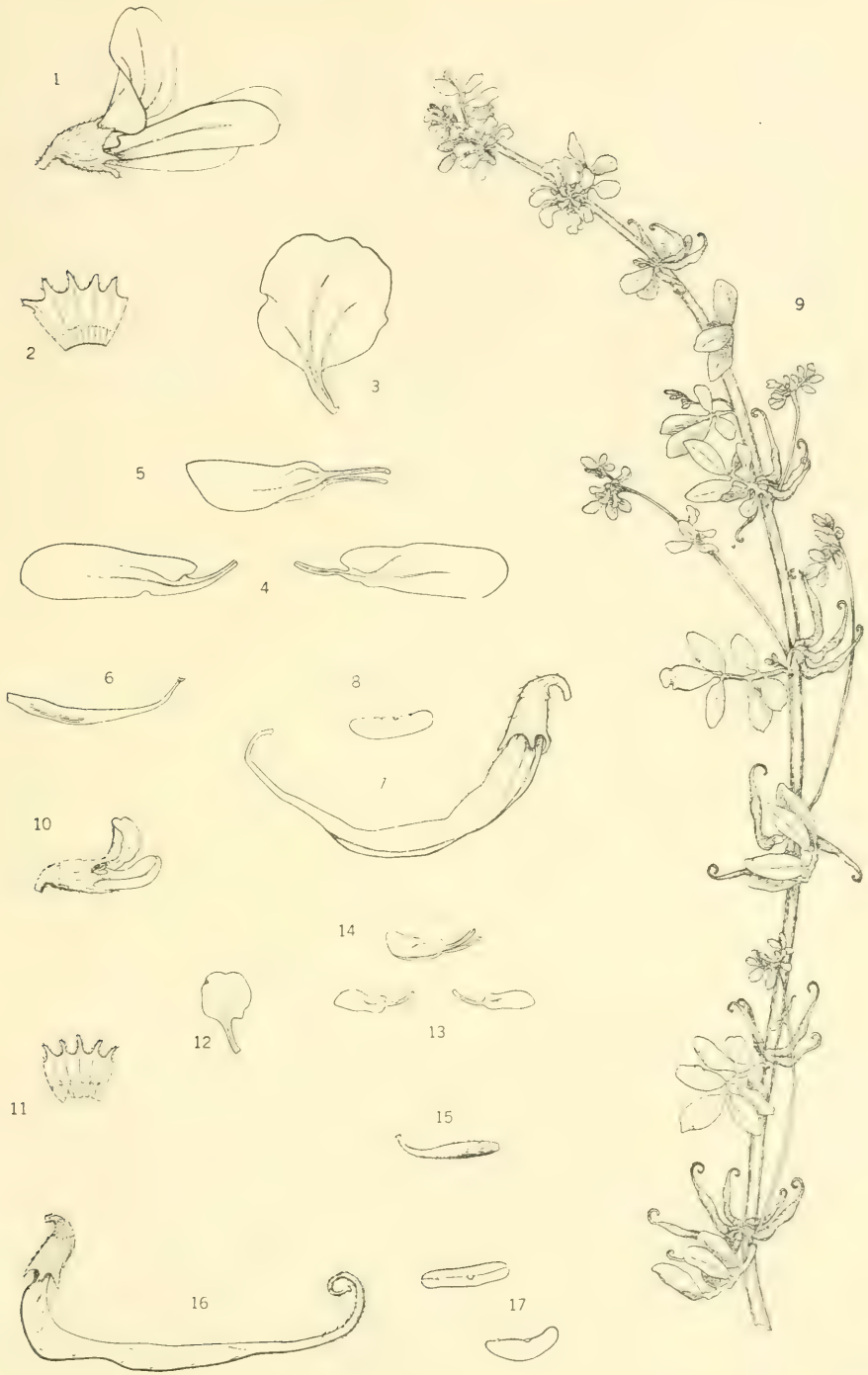
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PLATE 76

L. leucophyllus Greene

Fig. 1. Flower. × 4.
Figs. 2–6. Dissected flower. × 4.
Fig. 7. Fruit. × 4.
Fig. 8. Seeds. × 4.

L. benthamii Greene

Fig. 9. Flower. × 4.
Figs. 10–14. Dissected flower. × 4.
Fig. 15. Fruit. × 4.
Fig. 16. Seeds. × 4.

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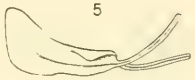
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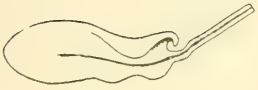
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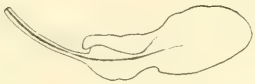

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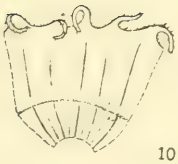
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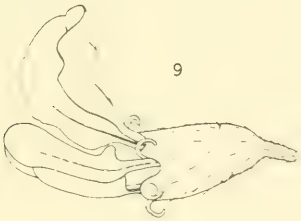
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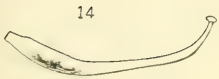
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PLATE 77

L. scoparius

Fig. 1. Habit. × 1.
Fig. 2. Flower. × 4.
Figs. 3–7. Dissected flower. × 4.
Fig. 8. Fruit. × 4.
Fig. 9. Seed. × 4.

L. scoparius var. *brevialatus*

Fig. 10. Flower. × 4.
Figs. 11–15. Dissected flower. × 4.
Fig. 16. Bud with banner removed. × 4.

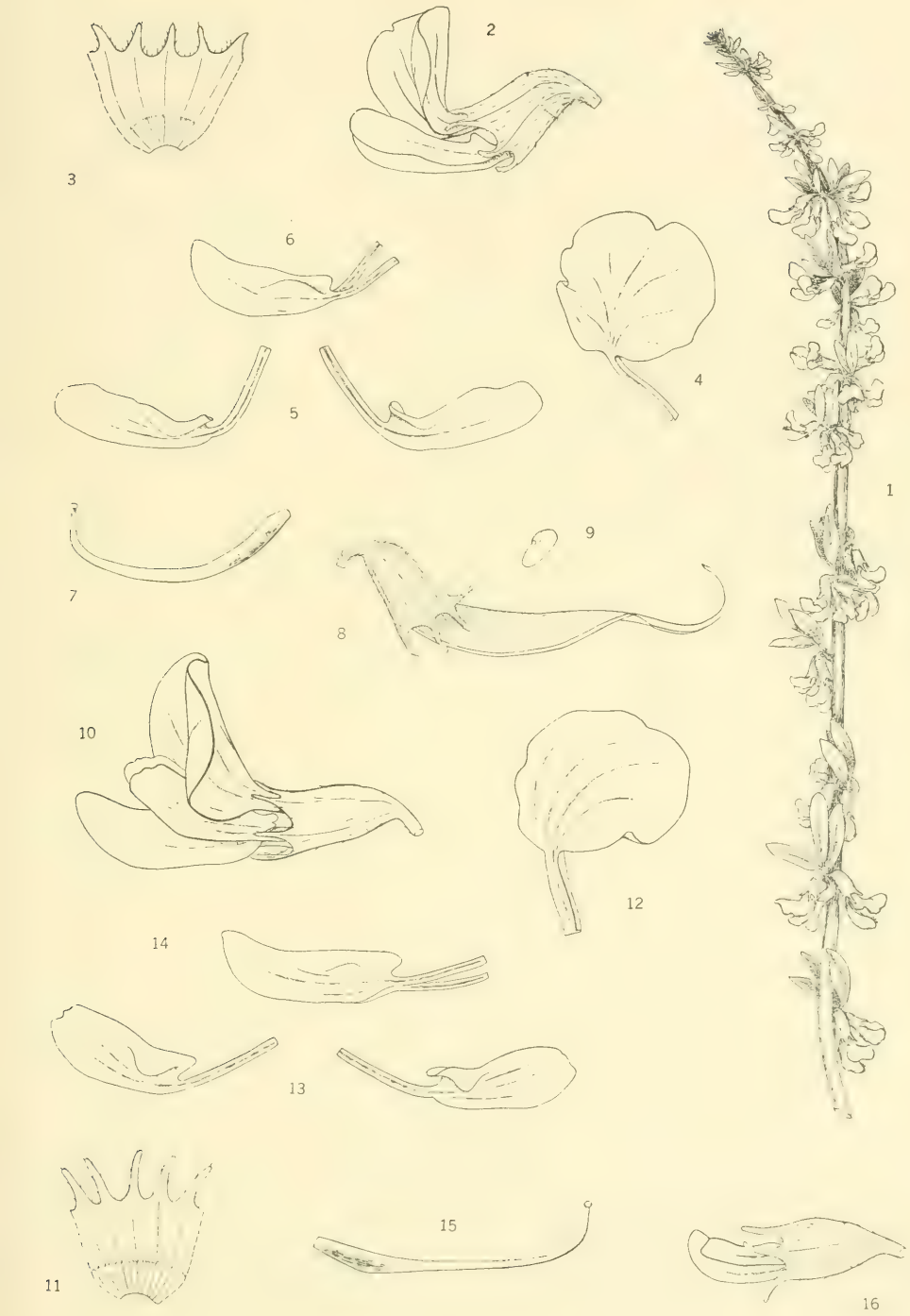
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PLATE 78

L. haydonii Greene

Fig. 1. Flower. × 4.
Figs. 2–6. Dissected flower. × 4.

L. junceus Greene

Fig. 7. Flower. × 4.
Figs. 8–12. Dissected flower. × 4.
Fig. 13. Fruit. × 4.
Fig. 14. Seed. × 4.

L. junceus Greene var. *biolettii*

Fig. 15. Flower. × 4.
Figs. 16–20. Dissected flower. × 4.
Fig. 21. Fruit. × 4.
Fig. 22. Seed. × 4.

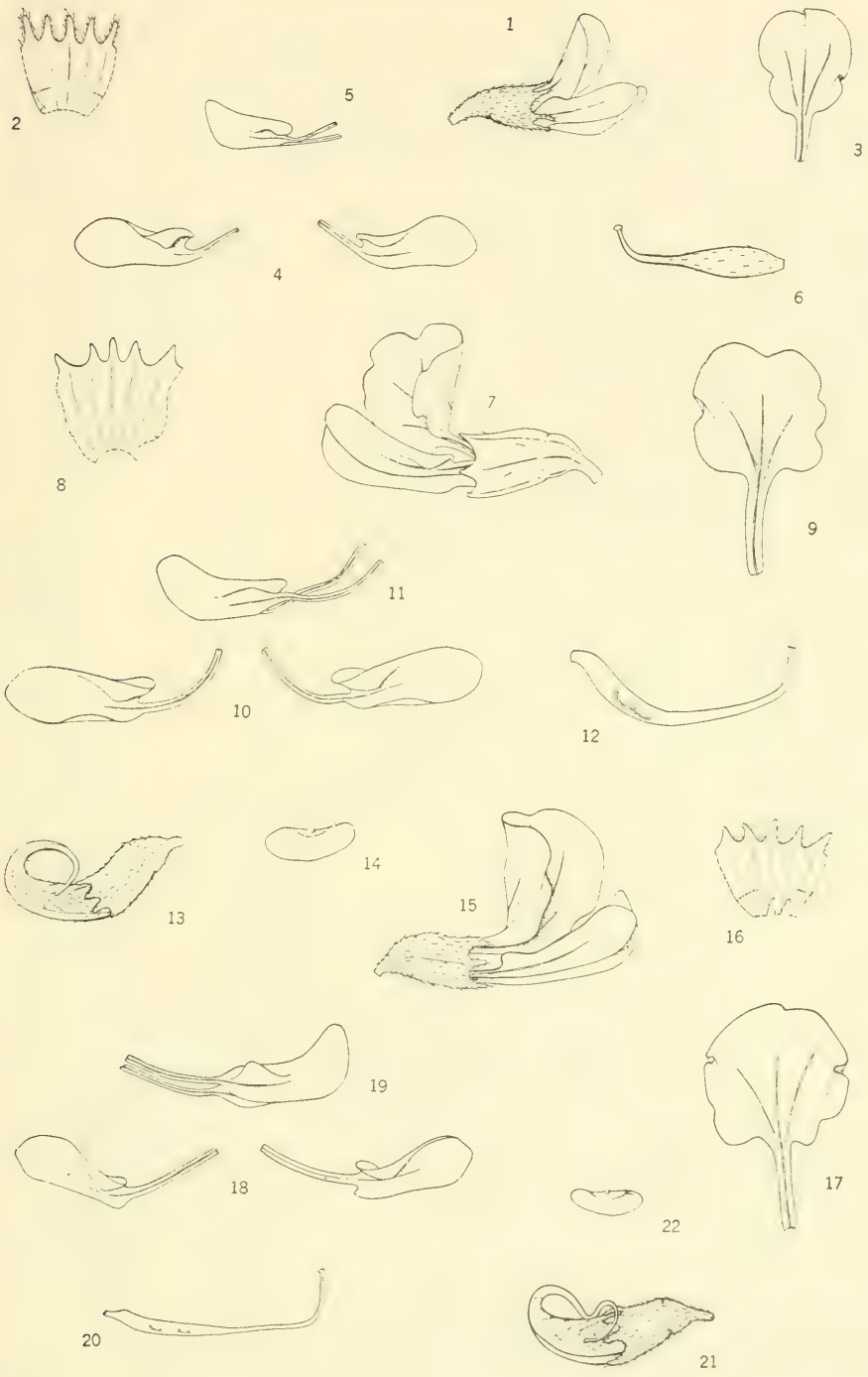
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PLATE 79

L. eriophorus Greene

Fig. 1. Habit. × 1.
Fig. 2. Flower. × 4.
Figs. 3–7. Dissected flower. × 4.
Fig. 8. Fruit. × 4.
Fig. 9. Seed. × 4.

L. eriophorus Greene var. *heermannii*

Fig. 10. Flower. × 4.
Figs. 11–15. Dissected flower. × 4.
Fig. 16. Fruit. × 4.
Fig. 17. Seed. × 4.

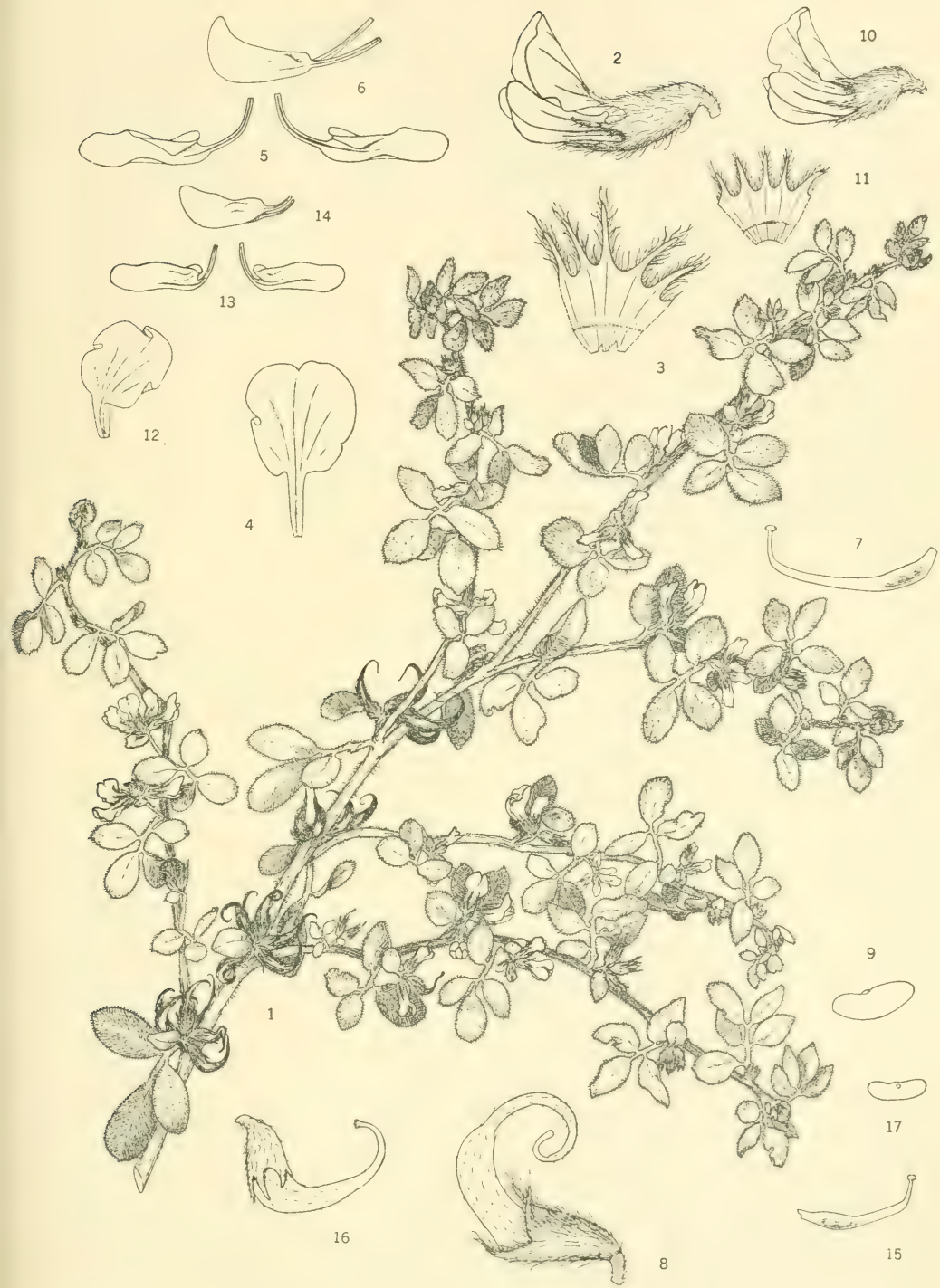
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PLATE 80

L. douglasii Greene

Fig. 1. Flower. × 4.
Figs. 2–6. Dissected flower. × 4.
Fig. 7. Fruit. × 4.
Fig. 8. Seed. × 4.

L. douglasii Greene var. *nevadensis*

Fig. 9. Flower. × 4.
Figs. 10–14. Dissected flower. × 4.
Fig. 15. Fruit. × 4.
Fig. 16. Seed. × 4.

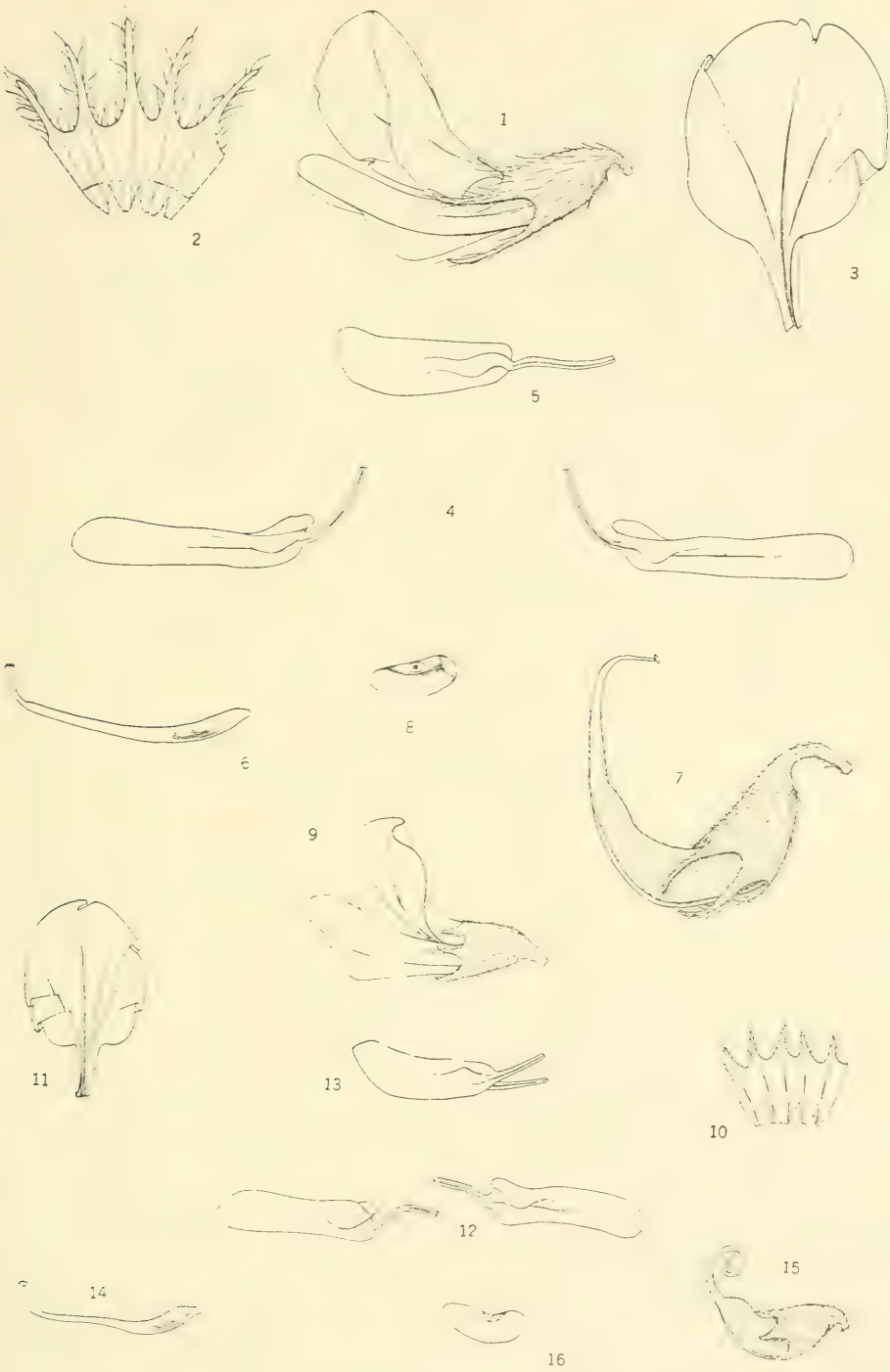
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PLATE 81

L. argophyllus Greene

Fig. 1. Flower. × 4.
Figs. 2–6. Dissected flower. × 4.
Fig. 7. Fruit. × 4.
Fig. 8. Seed. × 4.

L. argophyllus Greene var. *fremontii*

Fig. 9. Flower. × 4.
Figs. 10–14. Dissected flower. × 4.

L. argophyllus Greene var. *decorus*

Fig. 15. Flower. × 4.
Figs. 16–20. Dissected flower. × 4.
Fig. 21. Fruit. × 4.
Fig. 22. Seed. × 4.

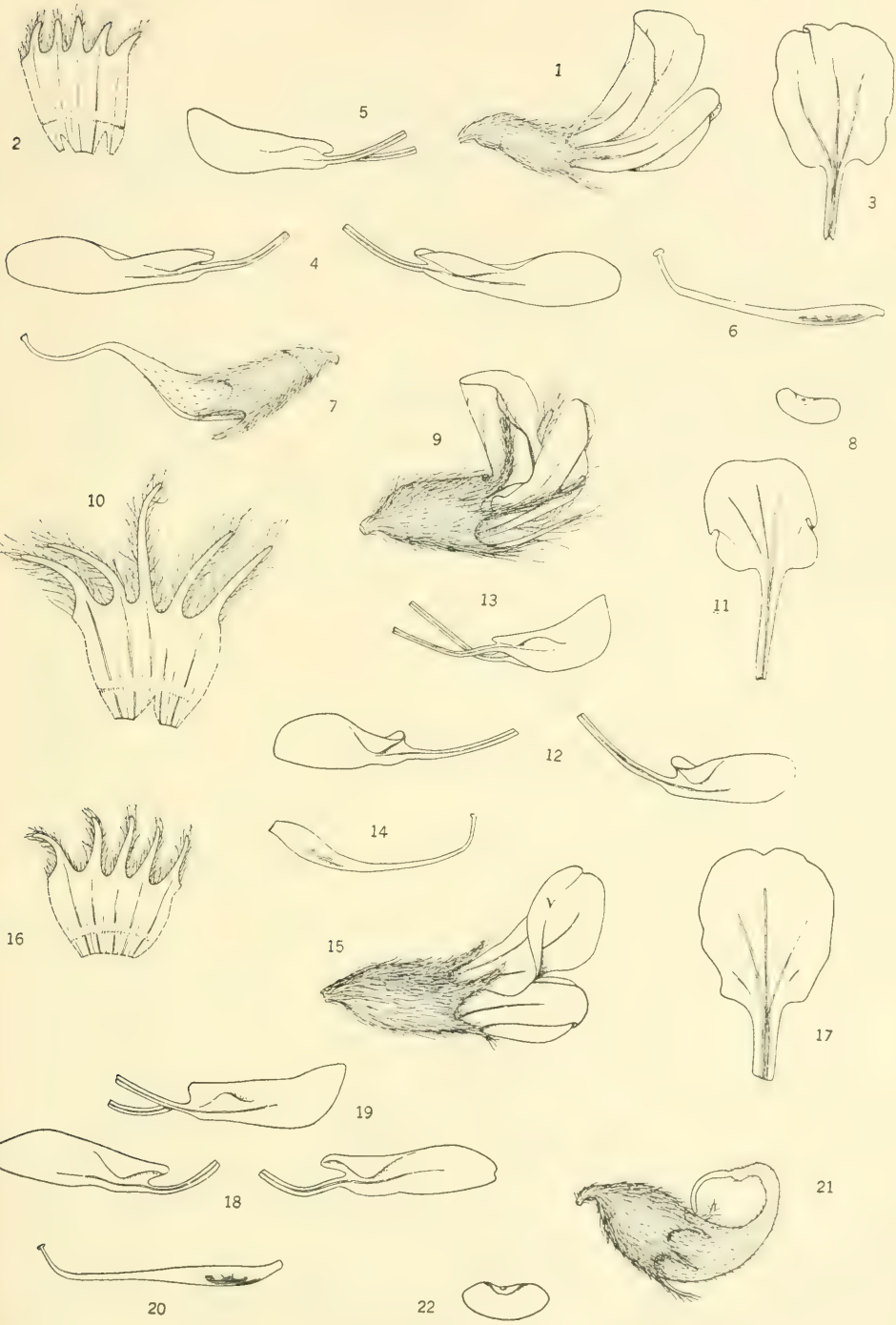
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PLATE 82

L. argophyllus Greene var. *niveus*

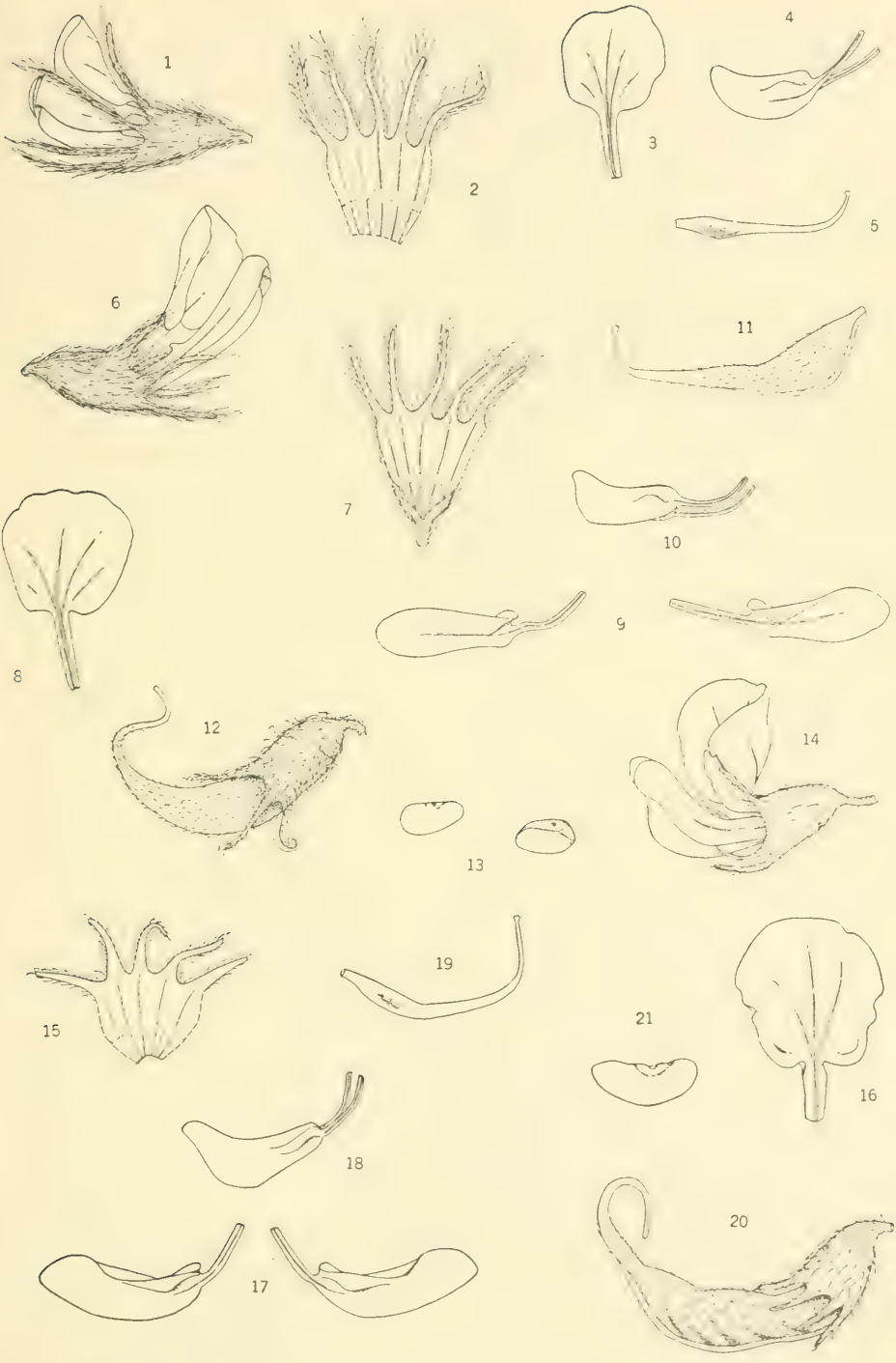
Fig. 1. Flower. × 4.
Fig. 2. Calyx. × 4.
Fig. 3. Banner. × 4.
Fig. 4. Keel. × 4.
Fig. 5. Pistil. × 4.
Fig. 6. Older flower, corolla persistent with the fruit. × 4.
Figs. 7–11. The older flower dissected. × 4.

L. argophyllus Greene var. *ornithopus*

Fig. 12. Fruit. × 4.
Fig. 13. Seeds. × 4.

L. davidsonii Greene

Fig. 14. Flower. × 4.
Figs. 15–19. Dissected flower. × 4.
Fig. 20. Fruit. × 4.
Fig. 21. Seed. × 4.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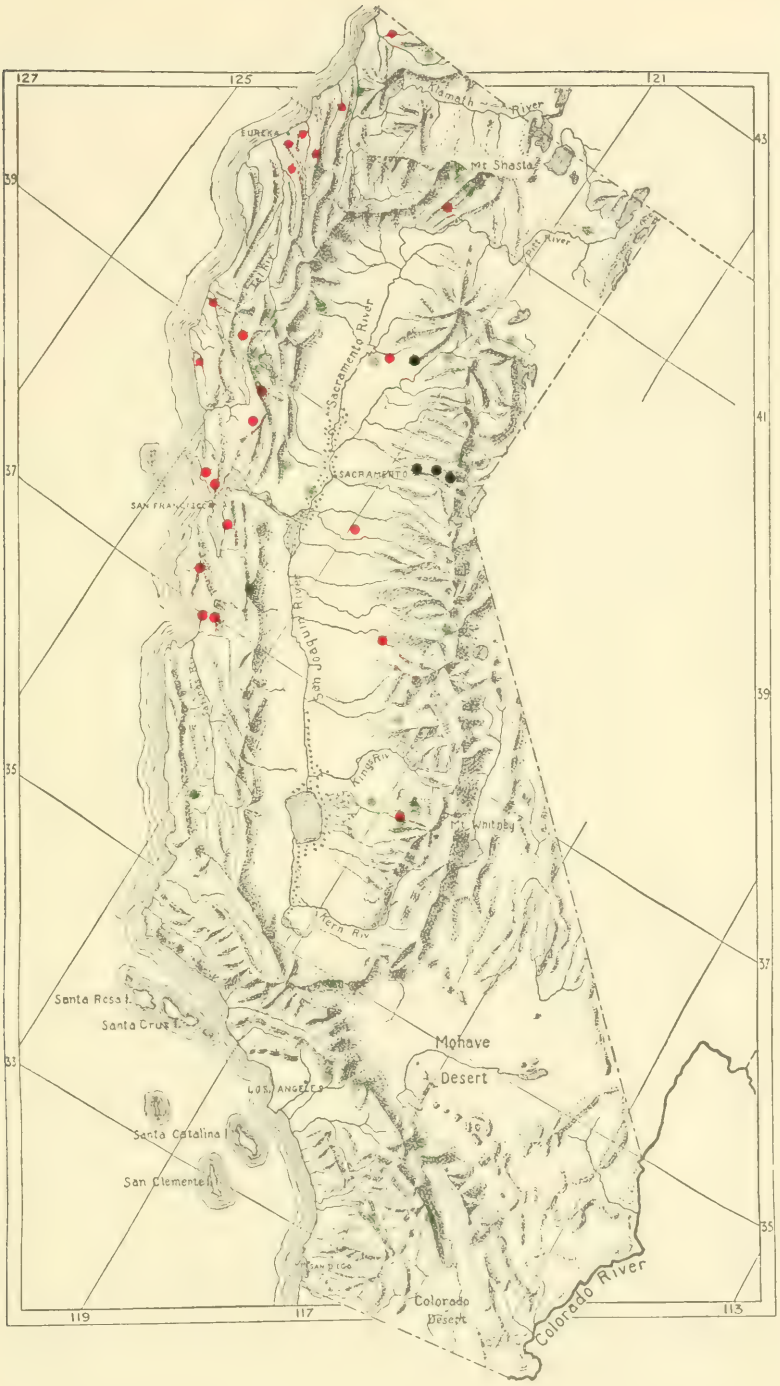
DISTRIBUTION MAP 1

- *Lotus incanus* Greene
- *Lotus stipularis* Greene
- *Lotus stipularis* Greene var. *subglaber*
- *Lotus crassifolius* Greene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Sacramento River
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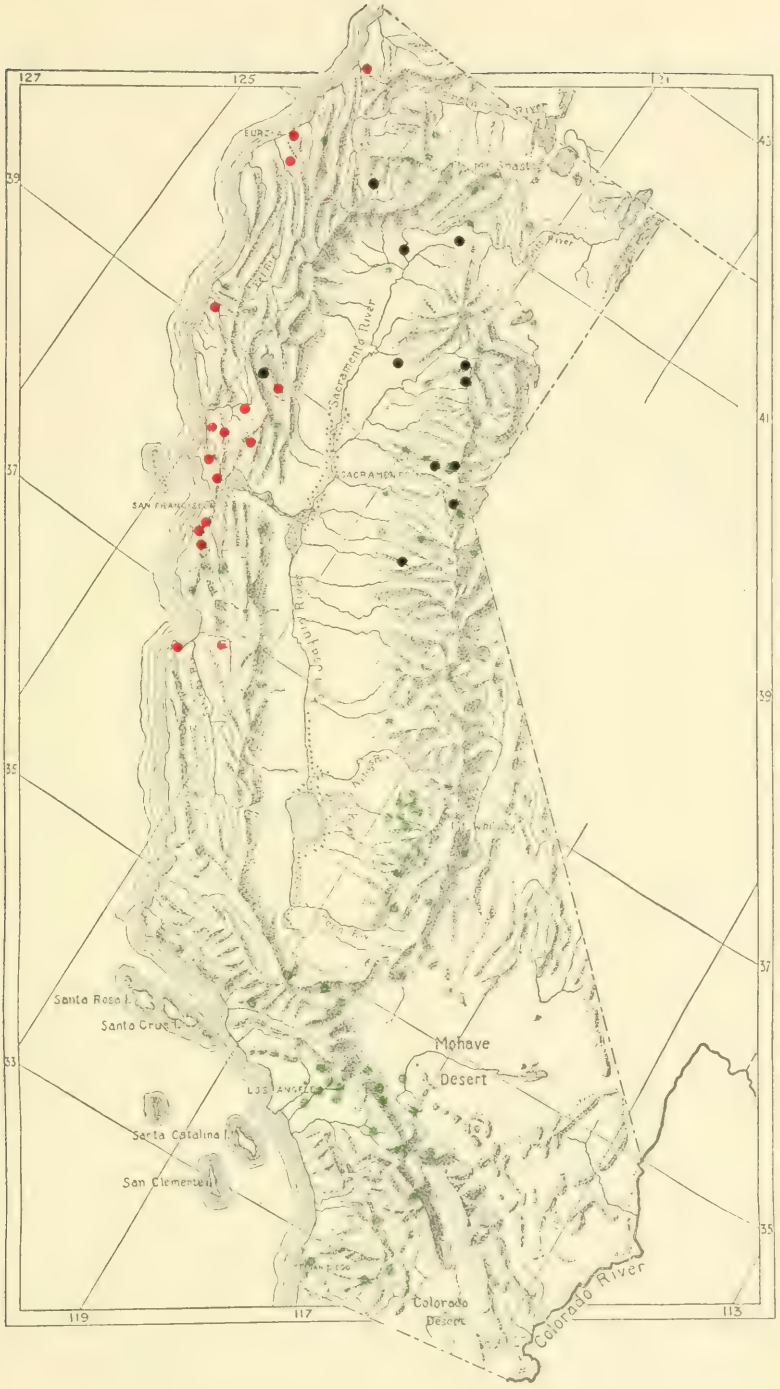
SAN FRANCISCO
San Joaquin River
Kings Riv
Mt Whitney
Santa Rosa I.
Santa Cruz I.
Mohave
Desert
LOS ANGELES
Santa Catalina I.
San Clemente I.
SAN DIEGO
Colorado
Desert
Colorado River

DISTRIBUTION MAP 2

- *Lotus pinnatus* Hook.
- *Lotus formosissimus* Greene
- *Lotus oblongifolius* Greene
- *Lotus oblongifolius* Greene var. *torreyi*
- *Lotus oblongifolius* Greene var. *cupreus*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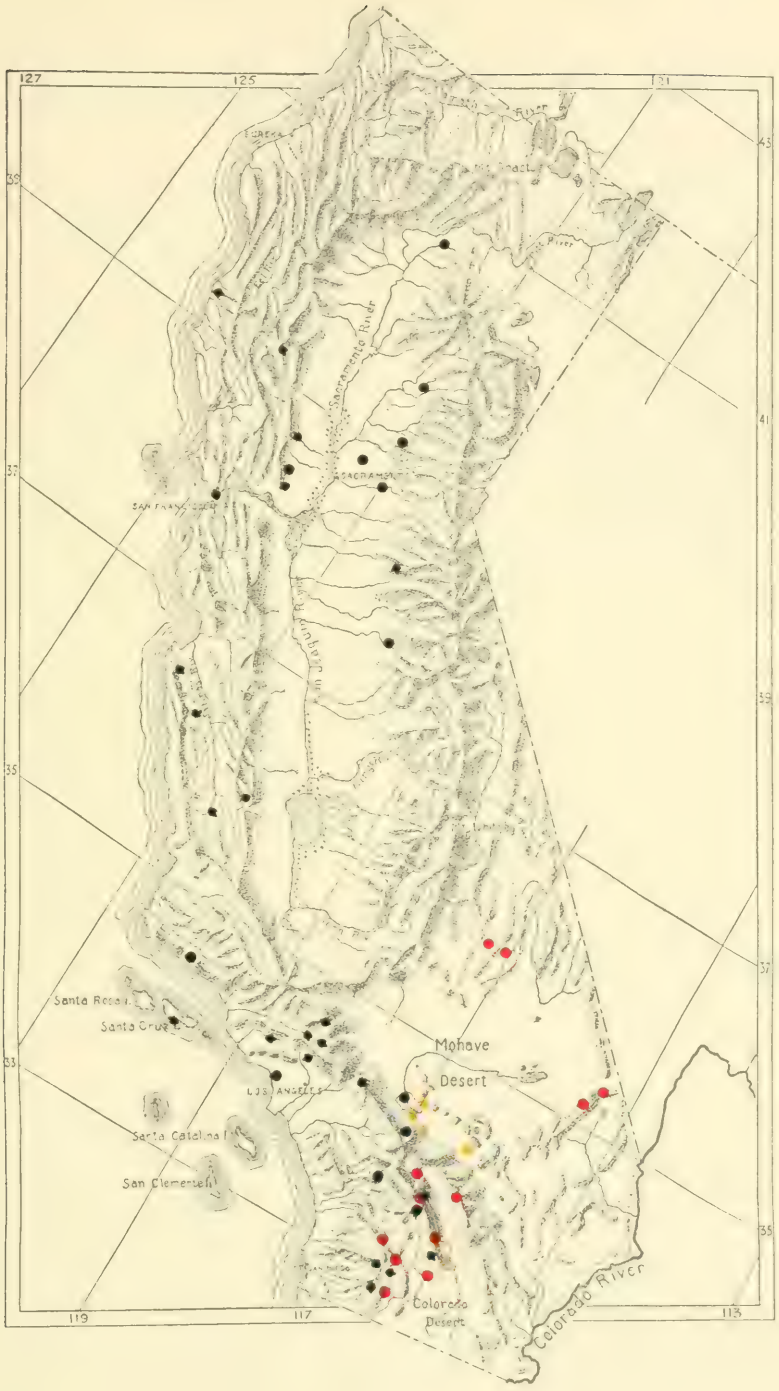
Santa Catalina I.
San Clemente I.

DISTRIBUTION MAP 3

- *Lotus grandiflorus* Greene
- *Lotus grandiflorus* Greene var. *mutabilis*
- *Lotus rigidus* Greene
- *Lotus wrightii* Greene var. *multicaulis*
- *Lotus argyraeus* Greene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Santa Cruz I.
LOS ANGELES
Santa Catalina I.
San Clemente I.
Mohave
Desert
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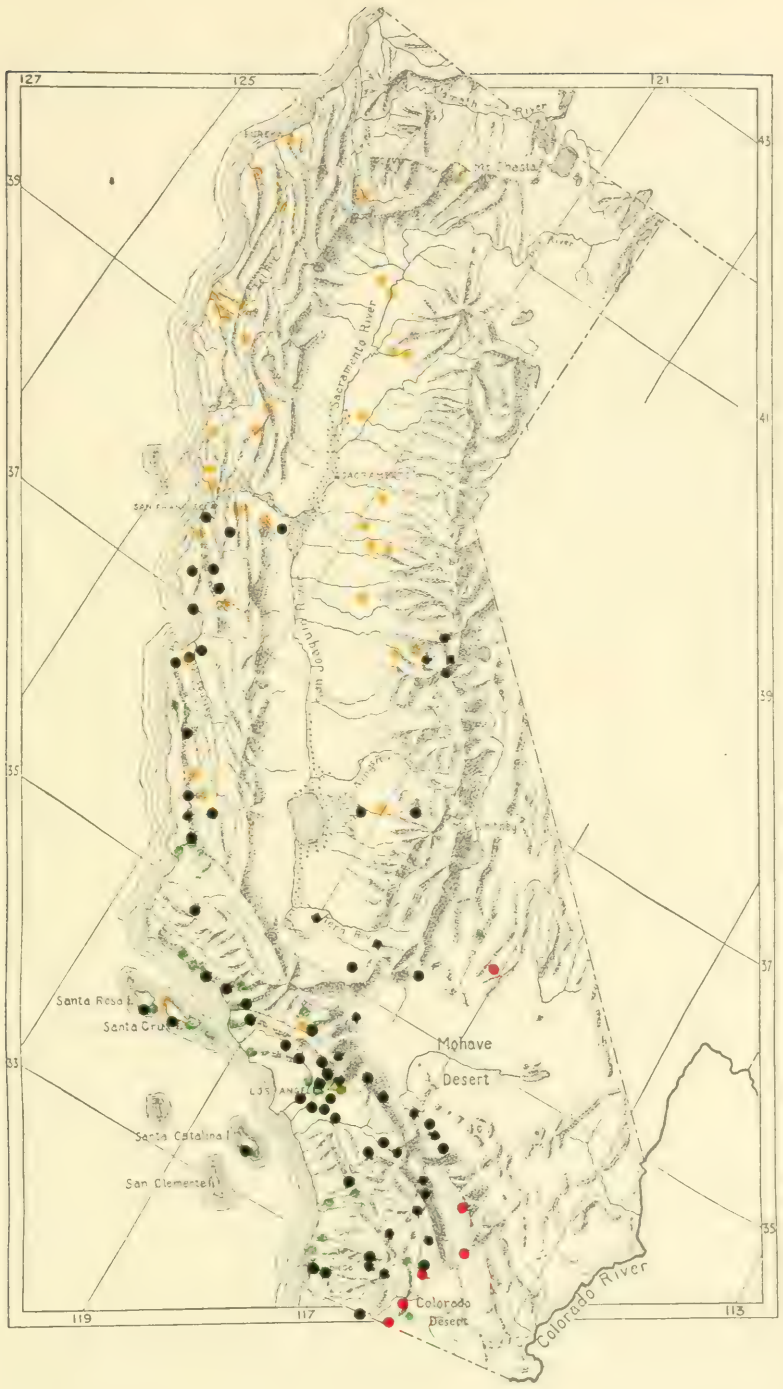
Desert
Colorado River

DISTRIBUTION MAP 4

- *Lotus strigosus* Greene
- *Lotus strigosus* Greene var. *hirtellus*
- *Lotus tomentellus* Greene
- *Lotus salsuginosus* Greene
- *Lotus salsuginosus* Greene var. *brevivexillus*
- *Lotus micranthus* Benth.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DISTRIBUTION MAP 5

● *Lotus americanus* Bisch.

▲ *Lotus americanus* Bisch. var. *minutiflorus*

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Santa Catalina I.
San Clemente I.
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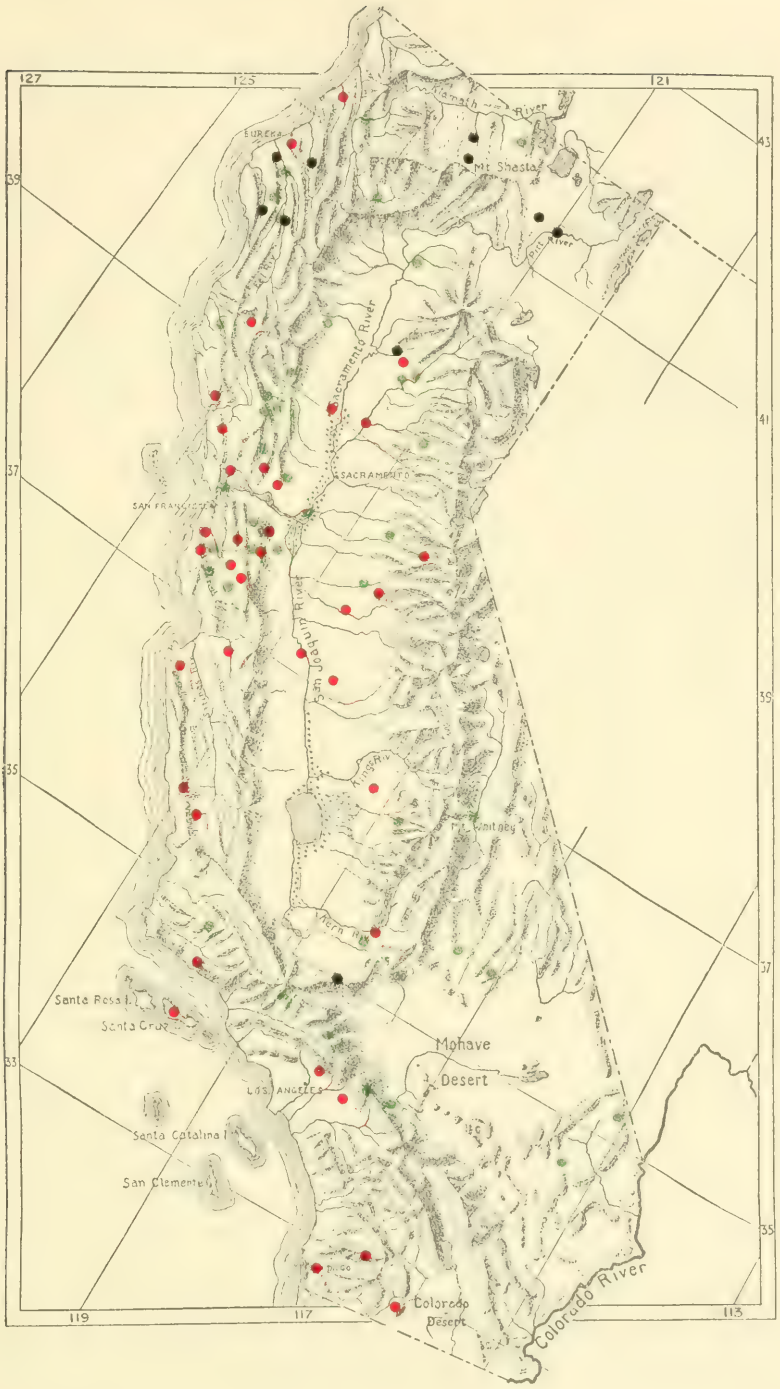
DISTRIBUTION MAP 6

- *Lotus denticulatus* Greene
- *Lotus subpinnatus* Lag.
- *Lotus humistratus* Greene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Desert
Colorado River

DISTRIBUTION MAP 7

- *Lotus nuttallianus* Greene
- *Lotus hamatus* Greene
- *Lotus leucophyllus* Greene
- *Lotus leucophyllus* Greene var. *jepsonii*

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Mt. Whitney
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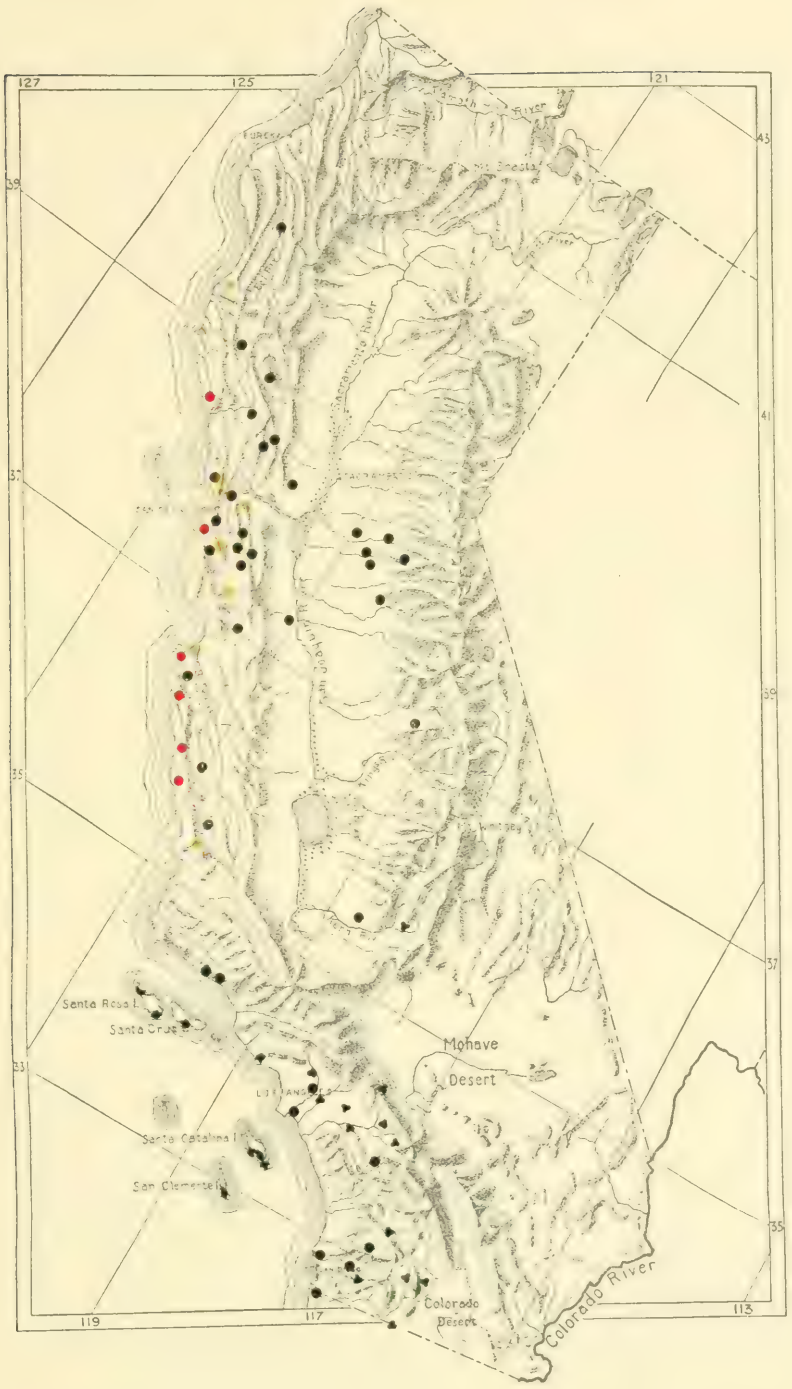
Santa Rosa I.
Santa Cruz I.
Santa Catalina I.
San Clemente I.
Mohave
Desert
Colorado
Desert
Colorado River

DISTRIBUTION MAP 8

- *Lotus scoparius*
- *Lotus scoparius* var. *dendroideus*
- *Lotus scoparius* var. *brevialatus*
- *Lotus scoparius* var. *traskiae*
- *Lotus scoparius* var. *veatchii*
- *Lotus benthamii* Greene
- *Lotus haydonii* Greene
- *Lotus junceus* Greene
- *Lotus junceus* Greene var. *biolettii*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Desert
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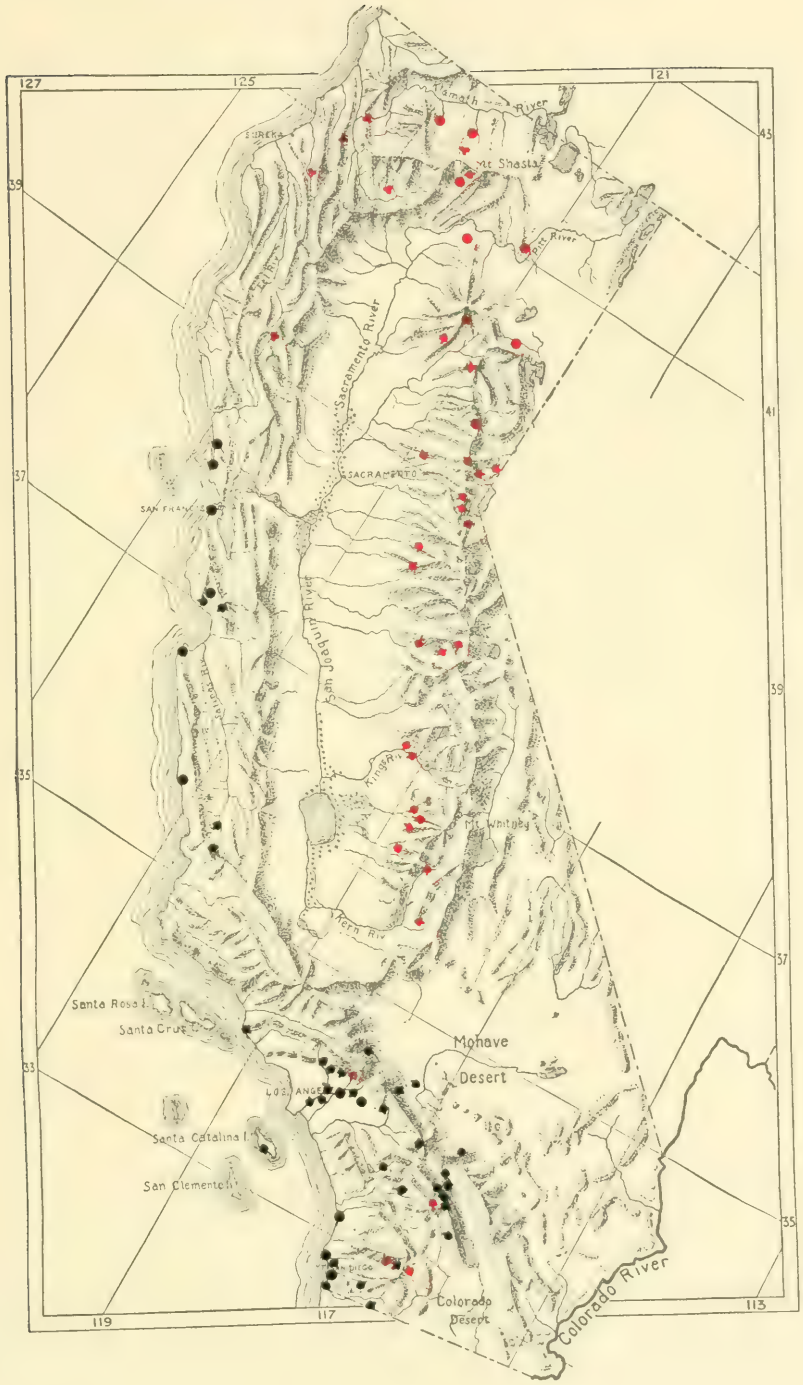
DISTRIBUTION MAP 9

● *Lotus eriophorus* Greene
♠ *Lotus eriophorus* Greene var. *heermannii*
● *Lotus douglasii* Greene
♠ *Lotus douglasii* Greene var. *nevadensis*
♣ *Lotus douglasii* Greene var. *congestus*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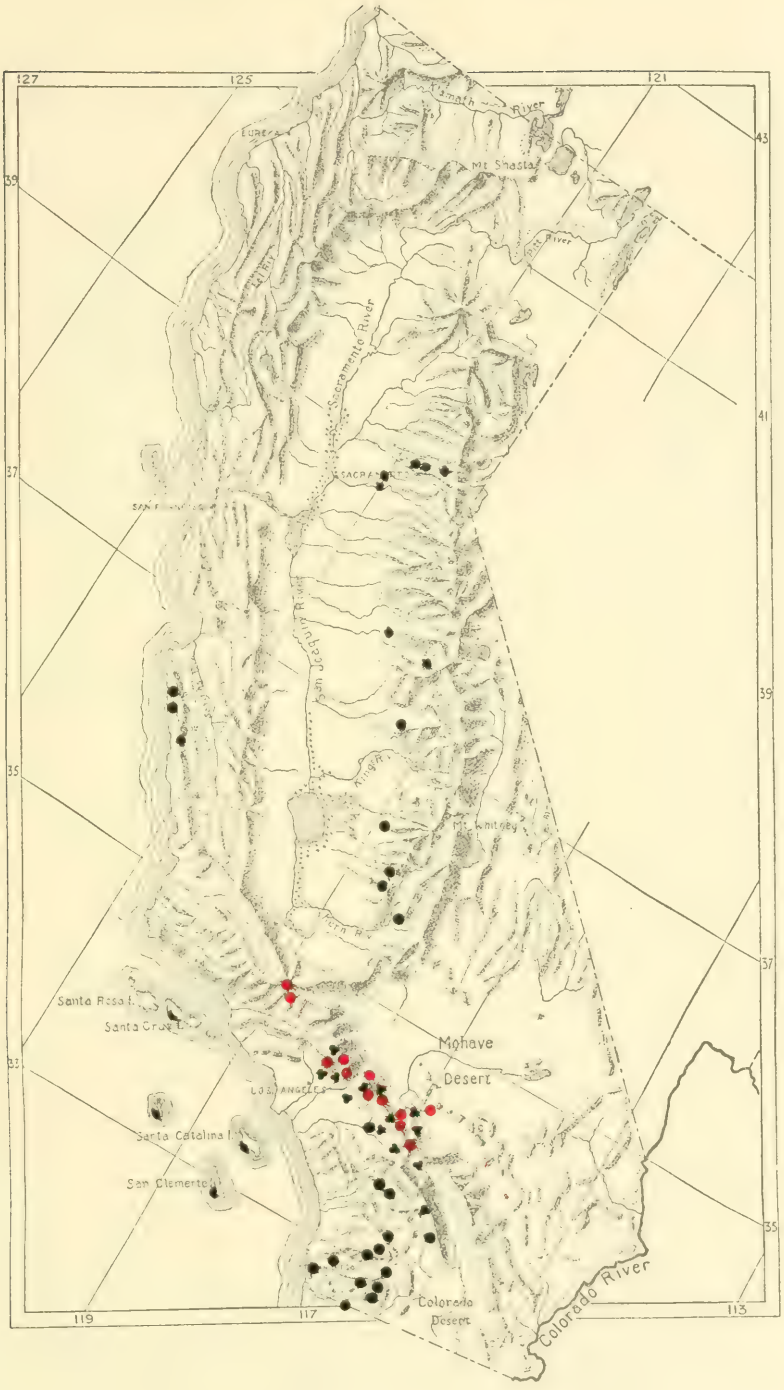
San Clemente I.
Colorado Desert
Colorado River

DISTRIBUTION MAP 10

- *Lotus argophyllus* Greene
- *Lotus argophyllus* Greene var. *fremontii*
- *Lotus argophyllus* Greene var. *decorus*
- *Lotus argophyllus* Greene var. *ornithopus*
- *Lotus argophyllus* Greene var. *niveus*
- *Lotus davidsonii* Greene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NOTES ON A COLLECTION OF NEW ZEALAND HEPATICAE

BY

WILLIAM HENRY PEARSON

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Since Archibald Menzies collected Hepaticae in New Zealand in 1791 (the specimens are in the Manchester Museum), a large number of species have been added by various collectors and named by Mitten, Stephani, Colenso, and other authorities. These are all enumerated by Stephani in his Species Hepaticarum and Supplement up to 1918. Colenso published as new a great many species in the Transactions of the New Zealand Institute, most of which have been examined by Stephani, and a revision of the same published in the Journal of the Linnean Society for 1893. I have not been able to find that any New Zealand Hepaticae have been published since 1918.

The present collection was made by Professor Setchell in 1904. Although small, it contains some interesting species and its examination has afforded me much pleasure. There may be errors in judgment, where I have not had the opportunity of comparing the specimens with the original types, but I have been very fortunate in being able to do so in many cases, for the Manchester Museum is very rich in types of New Zealand species from the Carrington and Spruce collections.

Although Stephani records many New Zealand species from Tasmania and Australia, he intimates in one of his notes that he is of the opinion that the Hepatic Flora of New Zealand is almost endemic, and with this opinion I agree.

The type specimens of all species described as new are deposited in the Herbarium of the University of California and duplicates of the same, as far as the specimens would allow division, are also deposited in the Manchester Museum in England.

Marchantia Setchellii sp. nov.

Plate 83

Dioicous. Medium size; dark glaucous green in color; densely caespitose. Fronds dichotomous, ligulate, equal breadth, cross-section plano-convex, 20 to 25 cells thick at the middle, cortical cells two layers, dark-colored, similar in size to the inner, margin of fronds often recurved, marginal cells smaller than others. Scales light purple, oval, rotundate or obtuse, distinctly dentate, teeth short; appendages deep purple, lanceolate-acuminate or ovate-acuminate, dentate, teeth often long and hamate; cells oblong-quadrate.

Stomata numerous, round or oblong, three tiers of cells high, 8 marginal cells, inner quadrate.

Cupules shallow, dilated, fringe dentate, teeth 1 to 3 cells long.

Dimensions.—Fronds 1 to 1½ inch long; 2 to 3 mm. wide; .5 mm. thick at the middle, margin .1 mm. thick, marginal cells .01 to .02 mm.; median scales .4 mm. × .45 mm., .35 mm. × .3 mm., cells of same .05 mm. × .02 mm.; appendages .6 mm. long × 2 mm. broad, cells of same .075 mm. × .05 mm.; teeth of fringe of cupule .1 mm. long; stomata .6 mm. diam.

Habitat.—Slopes near Waimangu, North Island, W. A. Setchell, 1904, no. 160. Type, Herb. Univ. Calif., no. 213707.

Observations.—Although the specimens received from Setchell are all sterile, I have no hesitation in considering this a new species. Evans, in The American Species of Marchantia (Trans. Conn. A. & S., vol. 21, 1917), notes the specific value of the appendages; in this species they are very distinct from any of those of any other species recorded from New Zealand. The only one that has somewhat similar ones is *M. papillata* Raddi, a South American species, although *M. platycnemos* Schwaegr. from the Falkland Islands has been doubtfully referred to this species.

I have not had the opportunity of examining any specimens of *M. papillata* except those of *M. subandina* Spruce, which has been reduced by Evans to a synonym of *M. papillata.*

M. subandina Spruce is similar in size, but the lobes are more erect, not widely spreading, and in some forms fastigiate; in a cross-section they are 10 to 15 cells thick at the middle, which gradually become thinner in the lamina. In the examination of *M. subandina* I noticed a singular feature. Many of the cross-sections showed, on the ventral side, the bulging out of a semicircular band of 5 cells × 5. This feature disappears on the younger fronds.

In *M. Setchellii* the fronds are 20 to 25 cells thick at the middle and abruptly become thinner winged.

In *M. subandina* the appendages are usually smaller, ovate acute, not longly acuminate, with only a few teeth (2 or 3), not 10 to 12, which are large and often hamate.

The median scales to which the appendages are attached in *M. subandina* and in all other species I can remember examining have an entire margin; in *M. Setchellii* they are distantly and shortly dentate.

In all the exhaustive particulars given by Evans of *Marchantia*, I have not seen such a character noted.

No description of cupules of *M. subandina* is given by Dr. Spruce (Hep. Am. et An., p. 561, 1884) for the simple reason, I suppose, that he could find none. I have examined a considerable number of fronds in the specimens distributed by him, with the same result.

No species from New Zealand is listed by Stephani in his Sp. Hep. to which I can refer *M. Setchellii*.

M. Berteroana L. & L. is recorded by Evans from New Zealand, "W. A. Setchell, North Island, 1904, no. 32"; I have not received this packet from Setchell.

Riccardia marginata (Colenso) comb. nov.

Plate 84

Aneura marginata Colenso, Trans. New Zeal. Inst., 1885. Stephani, Sp. Hep., Bull. Herb. Boiss., p. 259, 1899.

Dioicous. Small; brown in color; corticolous; densely and intricately caespitose. Fronds irregularly furcate, 10 cells wide, 5 cells thick at the middle, cortical cells very small, 40; plano-convex winged, wings composed of one row of single cells, very distinct; branches plane or slightly plano-convex, two cells thick at the middle; apices retuse or emarginate. Calyptra cylindrical, short, apex papillose, cuticle with few (5 or 6) conical tubercles; a cross-section disclosed a peculiar feature, the calyptras are slightly compressed with 6 cells thick at two sides, 2 to 4 cells thick at one side and one cell thick at the other. Spores minute, greyish-brown, angular, smooth; elaters reddish-brown, mono-spiral, 8 to 10 turns.

Dimensions.—Fronds ¼ to ½ inch long; .8 mm. wide, .25 mm. thick at the middle; branches .75 mm. wide, .125 mm. thick at the middle; marginal cells .04 mm.; calyptra 1.6 mm. × .7 mm.; capsule .7 mm. × .5 mm.; spores .0075 mm.; elaters .15 mm. × .01 mm.

Habitat.—Kahikanui near Whakapara, North Island, New Zealand. Coll. W. A. Setchell, July 8, 1904.

Observations.—Agrees well with Stephani's description of *Aneura marginata* Colenso.

Riccardia bistrata sp. nov.

Plate 85

Dioicous. Medium size, greenish brown in color; loosely caespitose. Fronds irregularly pinnate, very thin, bistratose, 40 to 50 cells wide with wings of layer of single cells 2 to 4 cells wide; branches 20 cells wide, unistratose. Imperfect flowers opposite, semicircular; bracts laciniate, laciniae 4 cells long, 1 to 2 cells wide.

Dimensions.—Fronds 1 inch long; 1.5 mm. wide; .05 mm. to .075 mm. thick; imperfect involucres .4 mm. × .4 mm.; laciniae of bracts .2 mm. long.

Habitat.—Pipiriki, North Island, New Zealand, May 29, 1904, Coll. W. A. Setchell. Type, Herb. Univ. Calif., no. 213706.

Observations.—This is the thinnest and most remarkable species of *Riccardia* I have seen, and none like it is recorded by Stephani in his Sp. Hep.; repeated cross-sections of the frond never show more than a layer of 2 cells, with the branches and young fronds unistratose.

That this may be an aquatic form of some other species is possible, but there are numerous imperfect female involucres on the fronds which indicate a certain maturity.

Riccardia riccioides sp. nov.

Plate 86

Dioicous. Small; dark brown in color, densely caespitose. Stems suberect, rhizomatous; rhizomes numerous, minute, terete, 10 cells in diam., often bearing male amentula; irregularly furcate, fastigiate, branches cuneate, broader than chief trunk which is thick, broadly oval on cross-section, 15 cells thick, 20 broad, margin acute, often 1 cell; cortical cells smaller, dark colored; branches broader and thinner, slightly biconvex, 10 cells thick × 30 cells wide, margin of trunk and branches often one cell winged. Calyptra pyriform, below slightly verrucose, above densely papillose, papillae long, striolate; apex coronate; on cross-section 6 cells thick, two outer layers of cells dark colored.

Male amentula basal radiate, 4 to 8 on a branch, rarely single, 4 to 5 pairs of alveolae.

Dimensions.—Fronds ½ to 1 inch long; trunk 1.25 mm. broad × .6 mm. thick; branches 2 mm. broad × .3 mm. thick; rhizomes .4 mm. diam.; calyptra 2.25 mm. × 1 mm. broad; corona .2 mm. high × .3 mm. wide; papillae .2 mm. long × .05 mm. thick; male amentula 1 mm. long × .4 mm. thick.

Habitat.—Mamaku Bush, North Island, New Zealand; coll. W. A. Setchell, 1904, no. 157. Type Herb. Univ. Calif., no. 213708.

Observations.—The general outline of the plant is like a *Riccia;* the chief characters, however, being the pyriform calyptra, the upper portion of which is densely papillose, with a very large corona and the numerous radiating amentula on the branches.

Riccardia alterniloba (Tayl.), the original specimens of which are in the Manchester Museum and have been examined by me, has, according to Stephani, two such similar characters, but it is quite a different species with very large lobate fronds not unlike *R. lobata* Schiffn.

Metzgeria atrichoneura Spruce

Trans Edinb. Bot. Soc., 1885. p. 296. Stephani, Sp. Hep., p. 298.

Habitat.—Otonga, Whakapara, North Island, New Zealand, coll. W. A. Setchell, July 9, 1904, no. 26.

Observations.—This is a very distinct species; costa with 2 antical and 2 postical cells, fronds with margins very involute, apices often cucculate, costa and wings nude, margin fringed with long, delicate cilia; male flowers smooth.

Spruce simply records it from New Zealand, place and name of collector not mentioned. Stephani mentions only New Zealand, Coll. Lauterbach.

Metzgeria ?

Near Hamurana Spring, Rotorua, North Island, New Zealand. Coll. W. A. Setchell, 1904, no. 156.

Observations.—Too small and imperfect to name; costa 2 cells wide on the antical and postical side; setae very few on costa, wings and margin.

Hymenophylum Phyllanthus (Hook.) Dum.

Habitat.—Mamaku Bush, North Island, New Zealand, coll. W. A. Setchell; 1904, no. 158.

Observations.—Fertile branches postical; involucre laciniate; perianth pluriplicate, mouth ciliate.

Symphyogyna undulata Colenso

Colenso MS; Stephani, Sp. Hep., p. 340, 1900.

Habitat.—Pipiriki, North Island, New Zealand; coll. W. A. Setchell, May 27, 1904, no. 10.

Observations.—Specimens young and imperfect. Costa broad, 12 dark colored cells thick; fronds undulate, furcate; wings composed of several layers of cells; squamae large, incised and lacerate.

Symphyogyna microcalyptra sp. nov.

Plate 87

Dioicous. Medium size; pale to greenish brown in color; loosely caespitose. Fronds procumbent, somewhat rigid, bifurcate, ligulate, regular, slightly biconvex; costa broadly oval, 10 cells thick, gradually excurrent into wings, 3–3–2–2–1; wings 25 cells wide, unistratose; band of minute dark colored cells in middle of costa; cortical cells larger than inner, margin of fronds distantly dentate, teeth ascending, 3 to 6 cells long, 2 to 3 cells broad at base. Calyptra very small, trumpet shaped, corrugated when old, with numerous appendages and archegonia near the mouth. Bracts lobate, lobes obtuse.

Male fronds smaller, with bracts somewhat distant, not crowded near apex.

Dimensions.—Fronds 1 inch long; 4 mm. wide; segments 5 mm. long; costa .25 mm. to .3 mm. thick at the middle × .75 mm. broad, bracts 1 mm. long; calyptra 2.75 mm. long × .75 mm. wide at mouth; perigonial bracts .5 mm. long.

Habitat.—Kahikanui, near Whakapara, North Island, New Zealand, coll. W. A. Setchell, July 8, 1904, no. 19. Type, Herb. Univ. Calif., no. 213723.

Observations.—I have had the opportunity of comparing Setchell's specimens with various ones of *S. obovata* from Tasmania and New South Wales, from which they differ in several particulars, and they do not quite agree with Stephani's description of *S. obovata.*

The plants are brown to brownish green, with no trace of rose, more rigid, fronds ligulate, not narrowly oval, cortical cells of costa larger than inner (in *S. obovata* they are of equal size); marginal teeth erect, not projecting, 3 to 6 cells long, not 2, calyptra very small, 2.75 mm. long, not 10 mm. as Stephani says of *S. obovata.* My measurements of *S. obovata* are 5 to 7 mm. long; both the ♀ and ♂ bracts are more laciniate, the ♂ bracts more distant on the fronds, not crowded near the apex.

I have seen no specimens of *S. obovata* from New Zealand. Stephani says he has seen no fertile ones from that country, where the species is evidently rare. I have specimens of *S. grandibracteata* St., ex herb. Levier, Nova Zelandia, Waimata bush (Canterbury), May, 1901, legit T. W. N. Beckett, det. F. Stephani n. 2797, which although Stephani places it in another section (*A. Procumbentes*) is very similar to *S. obovata;* there are no calyptras on the specimen and the ♀ bracts are similar to and no larger than those I find on other specimens of *S. obovata.* Stephani describes *S. grandibracteata* as brownish-olive, Beckett's specimens are as green or greener than *S. obovata,* with costa abruptly changing to wings, and Beckett's specimen on cross-section shows a gradual transition as in *S. obovata,* 3–3–2–2–2–1.

S. pulchra Tayl. is reduced to a synonym of *S. obovata* by Stephani. This I agree with, after examination of original specimens in the Manchester Museum, collected by Drummond at Swan River.

Stephani points out (Sp. Hep., Mem. Herb. Boissier, no. 11, p. 43) that Mitten is wrong in referring the New Zealand plant to *S. rhizoloba* Schwaegr., a species which is distinguished at once from all allied forms by the distinctly thickened marginal cells.

Specimens named *S. obovata* ? Basket Island leg. Spezziganni, ex. herb. Massalongo, in the Manchester Museum agree with *S. obovata.*

Solenostoma brevissimum sp. nov.

Plate 88

Dioicous. Small, pale green to rose colored; densely caespitose, terricolous. Stems erect, simple, tender, 35 cortical cells, inner 12 in diam., similar to the cortical, radiculose up to apex, rhizoids few, delicate, hyaline. Leaves 3 to 6 pairs, spreading or ascending and then clasping the stem, distant, approximate or imbricate, slightly concave, oval, lower ones smaller and sometimes rounder, entire or retuse, cuticle smooth; cells medium size, quadrate or oblong-quadrate, walls thin, trigones small or wanting. Bracts similar to leaves, slightly larger, retuse or entire. Perianth projecting half beyond the bracts to which they are adnate at their base, narrowly oval, 130 single cells round near the middle, 4-keeled, keels irregular, rounded, mouth when young shortly tubular, setulose, afterwards lacerate.

Numerous delicate sterile stems with distant leaves entangled in the tufts.

No androecia seen.

Dimensions.—Stems ¼ inch long, with leaves 1.25 mm. wide, diam. .3 mm., leaves 1.25 mm. × 1 mm., 1.1 mm. × .9 mm., .9 mm. × .9 mm., cells .035 mm.; bracts 1.25 mm. × 1.1 mm.; perianth 1.5 mm. × .7 mm.

Habitat.—Whakerewarewa, Rotorua, North Island, New Zealand; coll. W. A. Setchell, 1904, no. 155. Type Herb. Univ. Calif., no. 213710.

Observations.—The *Solenostoma humile* Mitten, Royal Soc. 1879 listed by Stephani in Sp. Hep. (Bull. de l'Herb. Boissier, ser. 2, as of p. 50, 1906) is a myth.

From *Nardia humilis* Berggren, N. Zeal. Hep., p. 7, it differs in its oval leaves, not orbicular, trigones wanting or very small, not large, narrowly oval perianth not ovate.

The figure of the perianth represents a mature one; when young the mouth is small and shortly tubular with a few minute setae. I refer my species to *Solenostoma* Mitten on account of this character along with the perianth's being adnate to the bracts, but I consider that there are species included in the genus by Mitten and Stephani which ought to be placed elsewhere. *Jung. inundata* Tayl., a species with large underleaves, as Stephani correctly states, although Mitten in Handbook Fl. N. Z., says "without," is one, for instance.

Jungermannia inundata Taylor

Habitat.—Whakerewarewa, North Island, New Zealand; coll. W. A. Setchell, 1904. With no. 155.

Plagiochila Lyallii Mitten

Mitten, Fl. New Zealand, vol. 2, p. 132.

Habitat.—Mamaku, North Island, New Zealand, coll. W. A. Setchell, April 22, 1904.

Growing with *Plagiochila Kirkii* Mitt., no. 28.

Plagiochila Kirkii Mitten

Plate 89

Habitat.—Mamaku, North Island, New Zealand; coll. W. A. Setchell, April 22, 1904, no. 28.

Observations.—Very distinct species; stems 2 inches long, dark brown in color, leaves oblong triangular, antical margin very decurrent, postical margin ampliate, marginal teeth 6 cells long, hamate; mouth of perianth with 30 teeth, 6 cells long, 2 and 3 cells wide at base.

Plagiochila deltoidea Lindenberg, emend. Pearson

Plate 90

Dioicous. Medium size; olive green in color; caespitose. Stems simple or sparingly branched. Leaves homomallous; approximate or imbricate, alternate, antical (lower) margin patent-divergent (70°) to patent (50°), very slightly decurrent, margin much recurved, entire; postical (upper) margin extending beyond the stem, ampliate, with about 12 large distant teeth; outline of leaf semi-broadly trigonous; apex rotundate with 3 to 4 teeth; cells minute, smaller still near margin, roundish-quadrate, trigones distinct, basal cells narrow, elongate, wall ligneous.

Habitat.—Mamaku, North Island, New Zealand, coll. W. A. Setchell, April 22, 1904, no. 4.

Dimensions.—Stems 1 to 1½ inch long; leaves 3 mm. × 3.5 mm.; cells near margin .015 mm., at base .05 mm. × .02 mm.

Plagiochila neohoweana Pearson sp. nov.

Plate 91

Dioicous. Medium to largish in size; pale yellow to reddish brown in color; caespitose. Stems simple or sparingly branched, branches erect. Leaves alternate, imbricate, patent (50°) to erecto-patent (30°), antical (lower) margin slightly recurved, decurrent, entire or rarely with few distant teeth, postical (upper), slightly ampliate, covering the stem but rarely extending beyond, sometimes reflexed, coarsely dentate, teeth 10 to 12 straight or hamate, 6 to 8 cells long, with a broad base, 4 cells wide; outline semi-oblong, trigonous, apex truncate with 2 or 3 teeth; cells between smallish and medium in size, roundish-quadrate, large trigones, basal cells the same. Bracts somewhat similar to the leaves, only larger and longer, with lower margin 5 to 6 dentate. Perianth oval, truncate, mouth wide, 40 teeth, irregular in length, 4 to 10 cells long, 4 cells wide at base, straight or hamate; pedicel short; capsule reddish-brown. Androecia on short and small erect branches arising from apex of stem, intercalular; perigonial bracts much smaller than the leaves, erect, closely imbricate, ventricose at base, bilobed, lobes oval, entire or with few short teeth at apex.

Dimensions.—Stems 1½ to 2 mm. long; leaves 3 mm. × 1.5 mm., 2.5 mm. × 1.5 mm.; cells near margin and base .03 mm.; bracts 3.5 mm. × 1.75 mm.; perianth 3 mm. × 2 mm.; perigonial bracts 1.25 mm. × .75 mm.; antheridia .4 mm. × .3 mm.

Observations.—I have read somewhere, but I cannot remember where, that when a complimentary name is given to a plant, there should be no doubt as to its specific value; consequently I have given more time to the study of this plant than to any other in the collection, in order to satisfy myself as to its position, being anxious that it should stand good.

Stephani, after his description of *Plagiochila deltoidea* Lindenb. in his Sp. Hep. (Bull. de l'Herb. Boissier, ser. 2, vol. 4, no. 8, p. 783, 1904), says: "This plant probably does not occur in New Zealand and has been confused with *Plagiochila Howeana* St."

Lindenberg, the founder of *P. deltoidea*, gives Dusky Bay, New Zealand, as the first station for it, then Tasmania. The Barbados record may safely be deleted.

Although no indication is given, I think we may assume that the figures of *P. deltoidea* given on plate XXVII by Lindenberg in his Spec. Hep. are taken from New Zealand specimens, for in his notes on the species, he remarks that the Tasmanian form has "minutely denticulate leaves," probably constituting quite a distinct species from our more modern standpoint.

These figures undoubtedly represent Stephani's *P. Howeana*, much more accurately than the *P. deltoidea* from Tasmania and other countries. A careful re-examination of all my specimens named *P. deltoidea* disclosed several inaccuracies. I have one from New Zealand determined by Stephani which is *P. Banksiana*, and several others named by him from New Zealand are his *P. Howeana*. Gepp of the British Museum informs me that in a set of Exotic Hepaticae received from Stephani there are 4 specimens from New Zealand named *P. deltoidea* and none *P. Howeana*.

There is no doubt in my mind that Stephani is right in distinguishing the New Zealand forms from those from Tasmania and elsewhere; the darker green color, the shorter, more quadrate outline of the leaves, the more recurved antical margin of the leaves, the smaller cells, are distinctive, but Stephani does not make this clear in his descriptions. The narrow elongate ligneous-walled basal cells give the leaves at their base a broad vittate appearance, while in *P. deltoidea* they are large and roundish-quadrate with large trigones, very similar to the other cells. These characters enable a student to separate them readily, and although the proposal I am about to make may seem somewhat unusual, I make *P. Howeana* Stephani a synonym of *P. deltoidea* Lindenb. and propose for the Tasmanian and other similar forms the name of *P. neohoweana* Pearson, so as to retain the name of my valued friend, Dr. Marshall A. Howe, of whom Stephani says, "the plant bears the name of the distinguished North American botanist (the investigator of the California Hepatic Flora)."

Plagiochila gigantea (Hook.) Dum.

Jungermannia gigantea Hook., Musci exot., p. 22.

Habitat.—Mamaku, North Island, New Zealand; coll. W. A. Setchell, April 22, 1904, no. 6.

Plagiochila arbuscula (Bridel) L. et L.

Plate 92

Spec. Hep., p. 23.
Jungermannia arbuscula Bridel *in* Lehm. Pug. IV, p. 63.

Habitat.—Pipiriki, North Island, New Zealand; coll. W. A. Setchell, May 26, 1904, no. 15.

Lophocolea sp.?

Habitat.—Mamaku, North Island, New Zealand; coll. W. A. Setchell, April 22, 1904.

Observations.—I picked out a few stems of a small *Lophocolea* with androecia which I have not been able to refer to any in Mitten's or Stephani's lists of New Zealand species; the leaves are broadly ovate, .7 mm. × .6 mm., to shortly trigonous, .7 mm. × .6 mm., broad base with narrow apex, bidentate, sinus shallow, teeth 3 to 5 cells long; underleaves connate on one side with leaf obcuneate, bifid to below the middle, segments entire or with a small tooth near the base on either side.

Lophocolea heterophylloides Nees

Habitat.—Taupo, North Island, New Zealand; coll. W. A. Setchell, May 16, 1904, no. 23.

Observations.—This is a small sterile form, with leaves usually entire or retuse, occasionally a bifid leaf near the base of the stem is found, but the numerous minute flagelliferous shoots are always deeply bifid.

Chiloscyphus echinellus (Lindenb. & Gottsche)

See *P. Lyallii* Mitten, Fl. N. Z., 11, p. 141.

Habitat.—Growing on *Plagiochila Kirkii* Mitt., Mamaku, North Island, New Zealand; coll. W. A. Setchell, April 22, 1904.

Observations.—This is often confused with *Lophocolea muricata.* I have fine specimens sent to me under this name, collected by S. Chadwick, Hawke's Bay, North Island; also, from the same collector and same station, the true plant.

I have seen no mention by any observer that the leaves of *Lophocolea muricata* are papillose on their postical side. I find that to be the case with all specimens I have examined from New Zealand and Tasmania.

Sande la Coste in his description of his *Lophocolea horridula* says of the leaves, "dorsum papillis elevatis conicus, in ventre deficientibus." This is a species which has been referred to *L. muricata* by Stephani.

Lophocolea muricata according to Stephani has a very wide distribution. *Chiloscyphus echinellus* is restricted to New Zealand and Tasmania.

Zoopsis argentea Hook. & Tayl.

Hook, Hep. antarct., p. 167, 1844.
Jungermannia (*Metzgeria*) *argentea* Hook & Tayl., Jour. of Bot., p. 400, 1844.

Habitat.—Mamaku Bush, North Island, New Zealand; coll. W. A. Setchell, 1904.

Cephalozia (Prionolobus) hirta St.

Stephani, Sp. Hep., Bull. de l'Herb. Boissier, no. 8, 1908, p. 345.
Cephalozia dentata (Raddi) Mitten, Flora Tasmania, II, p. 222.

Habitat.—Taupo, North Island, New Zealand; coll. W. A. Setchell, May 16, 1904.

Observations.—I picked out a few sterile stems of a minute *Cephalozia* growing on *Frullania fugax*. The specimen is too meager to determine with certainty, but may be referred to *C. hirta* St. until better specimens are obtained.

It differs, however, from *C. hirta* in being only half its size, stems 3 to 4 mm. long, not 8; also the cuticle is papillose, of which no mention is made by Stephani, although specimens recorded from Queensland, by him, collected by C. J. Wild, have the same character.

Stephani does not report his *C. hirta* from New Zealand, although Colenso and Rodway record *C. dentata* from there, which according to Stephani's synonymy is the same as his *C. hirta.*

The plant is very minute, stems simple or once branched, branches postical, rhizoids few, delicate, ascending to apex of the stem; leaves distant, alternate, bifid to the middle, segments and sinus acute, denticulate, cuticle papillose.

Lembidium nutans (Taylor) Mitten

Mitten, Handb. N. Z. Fl., p. 754.
Spruce, On Cephalozia, p. 59.
Mastigobryum nutans Hook., Fl. Antarct., p. 160, t. 65; Lindenb. & Gottsche, Spec. Hep., p. 20, t. 22.
Micropterygium nutans Mitt., Handb. N. Z. Fl., p. 526.

Habitat.—Kahikanui, near Whakapara, North Island, New Zealand, coll. W. A. Setchell, July 8, 1904, no. 19.

Observations.—I am pleased to have found specimens of this species in the collection as it has given me the opportunity of studying the point raised by Dr. Spruce in On Cephalozia, p. 59, 1882.

Mitten in Hooker's Handbook of the New Zealand Flora, says of *Lembidium nutans*, "the stem is clothed with a vesicular coat." Spruce in a footnote adds, "Mitten attributes 'a loosely cellular coat' to the stem. There is, however, none such and the 'looseness' exists solely in the author's perceptions."

I know there was no love lost between these two authorities but I think this is the only instance where their loss of love is shown.

In Lindenberg & Gottsche's Spec. Hep., t. 22, is given a cross-section of a stem with an underleaf attached, which shows the stem to be thicker than it is broad. It is not so: it is broader than it is thick.

I find that the cortical cells are about the same size as the inner, but there is one peculiarity about the stem. At each lateral side, the central cell is usually larger and prominent, so that when the stem is observed lying flat it appears to have a loose cellular coat—a justification for Mitten's apparent looseness of observation.

Adelanthus falcatus (Hook.) Mitten

Handb. N. Z. Fl., p. 518, 1867.

Habitat.—Mamaku Bush, North Island, New Zealand; coll. W. A. Setchell, 1904 (with no. 157).

Bazzania adnexa (L. & L.) comb. nov.

Jungermannia adnexa L. & Lindenb., *in* Lehm. Pug., pl. IV, p. 56, n. 26, 10 fasciculi (1828–57), 1831?
Mastigobryum Novae Hollandiae Nees., Syn. Hep., p. 221 (1844).
Mastigobryum Sieberianum Lindenb., Syn. Hep., p. 222 (1844).

Habitat.—Mamaku Bush, North Island, New Zealand, coll. W. A. Setchell, 1904.

Observations.—Stephani (Sp. Hep., p. 855, 1908) justly restores the prior name of Lehmann & Lindenberg for this species, which has a very wide distribution in Australasia and which varies within certain limitations considerably. The comparison of actual specimens with the 20 figures in Lindenb. & Gottsche's beautiful plate 7, Sp. Hep., and the reduction of *M. Sieberianum* to a synonym confirm this.

Stephani also refers *Mastigobryum affinis* Mitt. (Fl. N. Z.) to this species. I have not had the opportunity of seeing it.

The oblong leaves, arcuate antical margin, straight postical one, with truncate, trilobate apex, segments often minutely denticulate, easily enable the species to be determined.

Bazzania fissistipa (St.) comb. nov.

Mastigobryum fissistipum Steph., Sp. Hep., vol. 3, p. 533, 1909.

Habitat.—Mamaku Bush, North Island, New Zealand; coll. W. A. Setchell, 1904, no. 157.

Observations.—Rhizoids very abundant proceeding from base of underleaves. Leaves brown in color, ovate, truncate, vittate; underleaves broadly obcuneate, quadrifid to the middle, segments lanceolate.

Lepidozia plumulosa Lehm. & Lindenb.

Plate 93

Dioicous. Medium size; pale yellowish brown in color; caespitose; flagelliferous. Stem broadly pinnate or bipinnate; branches close, ascending, patent (50°); cross-section shows 15 large cortical cells and inner cells 15 to 20 per diam. Leaves obliquely inserted, divided to the middle or below, segments 5 or 6, 6 cells long, 4 and 5 single with 2 to 4 wide at the base, disc 8 cells broad at the base and 20 cells broad at upper margin; cells rather large, 4, 5 and 6 sided, quadrate, walls thin, no trigones. Underleaves quadrifid to a little below the middle, obcuneate, a little wider than the stem; segments 5–7 cells long, 5 and 6 single, at the base 2 cells broad; branch underleaves

trifid. Perianth at the base of the stem on a short branch, narrowly and elongated ovate, 6-fold, 120 double row of cells at middle, mouth contracted and contorted, with 30 two-celled setae. Bracts obovate or oblong-quadrate, apex broad, ciliolate; bracteole oval, apex ciliolate. Androecia not seen.

Dimensions.—Stems 1 inch long; with leaves 1 mm. wide, diam. .3 mm., leaves with segments explanate .8 mm. long × 1.1 mm. broad; disc .3 mm. broad at base, .75 mm. at apex, segments .3 to .4 mm. long, .1 mm. wide at base; cells .05 mm.; underleaves .6 mm. × .6 mm. with segments explanate, disc .2 mm. wide at base, .4 mm. upper margin, segments .3 mm. long, .075 mm. to .1 mm. wide at base; bracts 1 mm. long × .75 mm. broad; bracteole .75 mm. × .5 mm.; perianth 2.25 mm. long × .9 mm. at widest part, apex .1 mm., setae .1 mm. long; archegonia .175 mm. × .05 mm.

Habitat.—Mamaku Bush, North Island, New Zealand; coll. W. A. Setchell, 1904.

Observations.—This is a very beautiful and distinct species. I have compared the specimens with the originals from Cape Horn, in the Manchester Museum, with which they agree, save that they are larger.

Lepidozia brevipinna sp. nov.

Plate 94

Dioicous. Largish size; light brownish green in color; densely erectocaespitose. Stems roundish, slightly frontally compressed, 35 cortical cells, slightly larger than inner, which are 20 broad and 15 high; ramose, pinnate or slightly bipinnate, pinnae short, distant, somewhat regular in length, attenuate, flagelliferous, often secund; slightly ascending, patent-divergent (70°), horizontal (90°) or slightly decurved. Leaves distant, approximate or imbricate near apex; lower (postical) margin slightly decurrent, insertion a little beyond the margin of stem, upper (antical) margin extending to middle of stem, slightly ampliate or truncate; concave, incurved, clasping the stem except on young branches; oblong-quadrate, quadrifid to about one-fourth, basal tooth smallest, segments narrowly triangular or lanceolate-acute, 4 to 7 cells wide at their base. Underleaves as wide as stem from which they stand off, quadrate, quadrifid to about one-third, segments subequal, narrowly triangular to lanceolate, acute or obtusate. Androecia terminal on short, narrow branches; bracts closely imbricate, trifid; bracteole oval, acute, bifid to the middle.

Dimensions.—Stems 1½ to 2 inches long; with branches 1 mm. wide; diam. .2 to .3 mm.; leaves .9 mm. × .7 mm., segments .2 mm.; cells .03 mm., underleaves .5 mm. × .5 mm., segments .2 mm., perigonial bract .5 mm. × .4 mm., perigonial bracteole .4 mm. × .2 mm.

Habitat.—Waiora Valley, Wairakei, North Island, New Zealand; coll. W. A. Setchell, May 4, 1904. Type, Herb. Univ. Calif., no. 213712.

Observations.—Belongs to the *L. quadriloba* group, from the type species of which it is to be distinguished by the lobes of the leaves and underleaves being much shorter.

It comes nearest to *L. Nova Zealandia* St., from the description, but specimens of the latter which I have seen, collected by J. Mecklejohn near Lake Wakatipu, New Zealand, and determined by Stephani, indicate that it is a smaller and more delicate plant, irregularly ramose, having leaves with larger cells, and underleaves much more deeply divided.

L. brevipinna is recognized at once by its graceful, regular shape, given to it by its short pinnae.

Isotachis Lyallii Mitten

Mitten *in* Fl. N. Z., II, p. 149, t. 100, f. 7.

Habitat.—Pipiriki, North Island, New Zealand; coll. W. A. Setchell, May 29, 1904; no. 12.

Isotachis minima sp. nov.

Plate 95

Dioicous. Small; pale green to reddish brown in color; creeping on other hepatics, terricolous. Stems prostrate, radiculose up to apex; rhizoids few, hyaline; simple or with one branch; cortical cells 40, similar to the inner 10 × 12. Leaves ascending, often secund complicate or very concave, outline broadly oval to rotund, bifid or trifid to one-fourth or one-third, segments triangular, acute, sinus rounded or acute, margin entire, rarely with a minute tooth near the middle; cuticule smooth; cells medium size, elongate, 4, 5, or 6-sided, walls thin, no trigones, numerous chlorophyll bodies in the cells. Underleaves transversely inserted, erect, oval or broadly oval, bifid to nearly the middle, segments triangular, acute, sinus rounded or acute, margin unidentate on one or both sides near the middle. Androecia terminal, 3 or 4 pairs of bracts; perigonial bracts smaller than the leaves, ventricose at the base, explanate (outline) broadly oval, bifid to nearly the middle, segments acute, sinus rounded, wide, margin entire or unidentate near the middle; perigonial bracteole oval, bifid to the middle or nearly so, segments lanceolate, acute, margin entire or unidentate; antheridia oval, 1, 2, or 3 in each bract.

Dimensions.—Stems ¼ to ¾ inch long, with leaves 1 mm. wide; diam. of stem. .3 mm.; leaves 1.25 mm. × 1 mm., seg. .3 mm.; 1 mm. × 1 mm., seg. .3 mm.; .9 mm. × .9 mm., seg. .3 mm.; .8 mm. × .7 mm., seg. .3 mm.; cells .04 mm. × .02 mm.; underleaves .75 mm. × .75 mm., seg. .3 mm.; .6 mm. × .5 mm., seg. .3 mm.; perigonial bracts .7 mm. × .6 mm., seg. .25 mm.; perigonial bracteole .5 mm. × .3 mm., seg. .2 mm.; antheridia .2 mm. × .15 mm.

Habitat.—Whakerewarewa, Rotorua, North Island, New Zealand; coll. W. A. Setchell, 1904, no. 155. Type, Herb. Univ. Calif., no. 213715.

Observations.—As I find several male stems of the same small size as the others, I take it that the stems met with are normal in size. So far as I know no *Isotachis* like it has been described before.

Lepicolea scolopendra (Hook.) Dum.

Rec. d'obs., 1835, p. 20.

Habitat.—Mamaku, North Island, New Zealand; coll. W. A. Setchell, April 22, 1904. With no. 28.

Lepidolaena clavigera (Hook.) var. **Stangeri** Gottsche

Habitat.—Mamaku, North Island, New Zealand; coll. W. A. Setchell, April 22, 1904. With no. 4.

Observations.—The reducing of *L. Taylori* (Gottsche) to a variety of *L. clavigera* (Hook.) by Mitten (Handb. Fl. N. Z., p. 529) may possibly account for the uncertainty which several collectors have shown as to *L. Taylori*, to judge by the various specimens I have received under wrong names.

Mitten simply says (when making it a variety): "var. *Taylori* Cauline leaves toothed and spinose on the ventral margin," but Gottsche, the founder of the species, saw more differences. The underleaves, to mention another character, are quite different. They are deeply quadrifid, with the segments spreading and irregularly laciniate-spinulose. In *L. clavigera* they are not so deeply divided and are entire, slightly calcarate at the base.

Lepidolaena papebrifolia (Gottsche) has underleaves much nearer to *L. Taylori* than has *L. clavigera*, but the segments are still more spinulose and ciliate than *L. Taylori* and can be at once distinguished from that species by the absence of laciniae on the antical base of the leaves.

The var. *Stangeri* G. to which Setchell's specimens belong, differs from type by having its branch-leaves sometimes dentate-serrate.

Schistochila nobilis (Hook.) Dum.

Rec., p. 15, 1835.
Jungermannia nobilis Hook., Musci Exot., t. 11, 1818.
Gottschea nobilis Nees, Syn. Hep., p. 21, 1844.

Habitat.—Mamaku, North Island, New Zealand; coll. W. A. Setchell, April 22, 1904; no. 153, no. 157.

Radula plicata Mitten

Plate 96

Flora N. Z., II, p. 154.
Stephani, Sp. Hep., vol. IV, p. 214, 1910.

Habitat.—Mamaku, North Island, New Zealand; coll. W. A. Setchell, April 22, 1904, no. 8 and no. 28.

Observations.—A very remarkable and distinct species. In addition to the perianth being plicate, a unique character in this genus so far as I know, the leaves on their antical (upper) margin are abruptly and acutely truncate.

Stephani remarks under *R. plicata* (Sp. Hep., vol. IV, p. 214, 1910) "that the folding of the perianth is usually not noticeable, and only in the old branches to be observed, evidently an indication of their coming decay." This is not so, for in the numerous perianths on Setchell's specimens they are of different stages of growth and the plication is always to be seen; in fact the ridges are really narrow wings, 1, 2 and 3 cells wide.

Its nearest ally is *R. physoloba* Mont., a species which Stephani does not think belongs to the New Zealand flora. The specimens he received from there, collected by Beckett, are so poor that the question is undecided.

There are specimens (3074) in the Manchester Museum named *R. physoloba* Mont. (I do not know by whom), collected by Sinclair in New Zealand, which are *R. plicata*, but they are without perianths. Also, there is a specimen named *R. physoloba* (*Jung. flavifolia* Tayl.) from Cape Horn (20569) which represents a distinct species as recognized by Taylor, Jour. of Bot., p. 476, 1844, the acute leaves at once distinguishing it.

Through the kindness of Professor Dismier I have had the opportunity of examining the original specimen of *R. physoloba* of Montagne. It is a different species from that collected by Weymouth in Tasmania and determined by Rodway, the lobes of the leaves being rounder, with the lobules having an acute angle.

The *Radula plicata* listed by Rodway in his Hepaticae of Tasmania, with the mouth of the perianth fimbriate, must belong to another species.

I have the pleasure of being able to add drawings from the original specimens of *Radula physoloba* Mont. and *Radula flavifolia* (Tayl.), (cf. plates 97 and 98).

Madotheca Stangeri G. L. & N.

Syn. Hep., p. 280, 1844; Stephani, Sp. Hep., p. 284, 1910.

Habitat.—Pipiriki, North Island, New Zealand; coll. W. A. Setchell; May 29, 1904. With no. 16.

Frullania (Galeiloba) Colensoana St.

Plate 99

Sp. Hep., vol. IV, 405.

Dioicous. Medium size; stems, reddish or greyish brown in color; intricately caespitose. Stems narrowly pinnate, sometimes irregularly ramose, pinnae unequal in length, sometimes long, ascending, erecto-patent (30°). Leaves imbricate, concave, lobe broadly oval, appendiculate, appendix triangular, acute; lobe galeate, mouth wide truncate. Underleaves three times broader than the stem, subcircular, slightly cordate or decurrent, very shortly bidentate, segments acute and apiculate.

Androecia on short terminal branches, globose or oblong-globose, or intercalular, 4–5 pairs of bracts, bracts divided to the middle, lobe obtuse, lobule acute, entire or with a minute tooth, bracteole spathulate, retuse.

Dimensions.—Stems 1½ inch long, with leaves 1.25 mm. wide; diam. .2 mm.; leaves, lobe .75 mm. × .7 mm., lobule .3 mm. × .2 mm.; cells .02 mm.; underleaves .5 mm. × .5 mm., .5 mm. × .4 mm.; perigonial bracts, lobe .5 mm. × .3 mm.; lobule .4 mm. × .25 mm.

Habitat.—Taupo, North Island, New Zealand; coll. W. A. Setchell, May 16, 1904.

Observations.—Stephani wrote to me some years ago that he had received from the Rev. Wm. Colenso 600 packages of New Zealand Hepatics. The species here named by him after Colenso is remarkable in having the large appendix of the leaf triangular and acute in shape. This can be well seen only by detaching a leaf from the stem and flattening it out with the cover glass. It is a remarkable character and I have not seen it in any other species.

Stephani in his description of the species says he had not seen the male plant. On Setchell's specimens there are several male stems.

Frullania (Galeiloba) fugax Tayl.

Plate 100

Jour. of Bot., p. 87, 1845.

Habitat.—Taupo, North Island, New Zealand; coll. W. A. Setchell, May 16, 1904, no. 25.

Bush near Waiotapu, North Island, New Zealand, coll. W. A. Setchell, 1904.

Observations.—In wetting the plant for examination, the leaves nearly all fall off, far more so than in *Frullania fragilifolia.* The plant has a reddish color, the lobule very large and underleaves small. I found numerous involucres but no perianths. Gemmae are very abundant on the margin of the leaves.

Frullania (Galeiloba) squarrosula Hook. f. et Tayl.

Plate 101

Fl. N. Z., II, p. 160, t. 103, f. 6.
Jungermannia squarrosula Hook. f. and Tayl., Jour. of Bot., Hep. Antarct. Suppl., p. 10, 1844.
Frullania (Galeiloba) squarrosula Tayl. Stephani, Sp. Hep., IV, p. 409, 1910.

Habitat.—Pipiriki, North Island, New Zealand; coll. W. A. Setchell, May 29, 1904, no. 16.

Observations.—Remarkable for its recurved squarrose leaves, which distinguish it at once.

It has been recorded only from New Zealand.

Frullania (Galeiloba) Setchellii sp. nov.

Plate 102

Dioicous. Medium size; reddish brown in color; corticolous; stratose. Stems irregularly ramose, bipinnate, pinnae and pinnulae short, spreading. Leaves horizontally inserted, imbricate, very slightly concave, broadly oval, longer than broad, entire, margin of some leaves very slightly and narrowly reflexed and darker colored, antical (upper) margin extending beyond the stem, a little ampliate, appendiculate, appendix obtuse; postical (lower) margin dependant; cells very small, basal ones rather larger, walls irregular, nodulose, trigones large and distinct. Underleaves large, 3 to 4 times broader than the stem, approximate, subcircular, sometimes very slightly cordate, bidentate to one-fifth, segments obtuse or rarely acute, sinus obtuse or acute.

Bracts, lobe oblong, entire, apex rotundate, lobule equal in length, lanceolate, with a long linear segment arising from base. Bracteole broadly lanceolate, bifid to the middle or below, segments acuminate with a blunt tooth on the exterior margins.

No perianth or androecia seen.

Dimensions.—Stems 1 inch long, with leaves .8 mm. wide; diam. .1 mm.; leaves, lobe .55 mm. × .4 mm., .5 mm. × .4 mm., lobule .3 mm. × .2 mm., cells .015 mm.; underleaves .425 mm. high × .4 mm. broad, .4 mm. × .4 mm., .35 mm. × .35 mm., .35 mm. × .3 mm.; bracts, lobe .9 mm. × .35 mm., lobule .9 .mm. × .2 mm.; bracteole .9 mm. × .4 mm.

Habitat.—Bush, near Waiotapu, North Island, New Zealand; coll. W. A. Setchell, 1904, no. 159. Type, Herb. Univ. Calif., no. 213713.

Observations.—The only species near it, from Stephani's description of New Zealand *Frullaniae*, is *F. falciloba* Tayl.; but this is a much more robust plant, with underleaves proportionately large, not so regularly circular, often a little angular and slightly dentate, lobe of bract acute and sometimes dentate, lobule dentate and bracteole dentate.

Stephani does not record *F. falciloba* Tayl. from New Zealand, but Mitten does (Wairapara Valley on bark, Wm. Colenso). I have specimens from New Zealand collected by Colenso, ex herb. Curnow, named *F. falciloba*, which are quite different from the description, lobule spiniferous, underleaves irregular in shape, deeply, divided with margin more or less dentate.

Frullania (Diastoloba) rostrata (Tayl.) Hook. et Tayl.

Syn. Hep., p. 445; Stephani, Sp. Hep., vol. IV, 1911, p. 661.
Jungermannia rostrata Tayl., Jour. of Bot., 1845, p. 87.

Leaves apiculate, perianth triplicate, narrowly oblong, long beak, bracts lobe lanceolate acute or acuminate, entire, lobule same only smaller.

Habitat.—Bush near Waiotapu, North Island, New Zealand; coll. W. A. Setchell, 1904. With no. 159.

Anthoceros? nostocoides sp. nov.

Plate 103

Sterile. Largish in size; olive green in color; densely stratose. Fronds bi-trifurcate, lobes erecto-patent (30°), linear, regular, slightly plano-convex, 3 to 4 cells thick at the middle, gradually thinning to margin which is one cell thick; cortical cells very small and indistinct, inner large and irregular in size, hyaline; lobulate; lobules few, 3–4; cuticle smooth; postical side with numerous narrow oval Nostoc colonies imbedded in the fronds.

Dimensions.—Fronds 1 to 2 inches long, 3 to 5 mm. wide, .2 to .3 mm. thick; Nostoc colonies .5 mm. long × .25 mm. wide.

Habitat.—Pipiriki, North Island, New Zealand; coll. W. A. Setchell, 1904, no. 14. Type Herb. Univ. Calif., no. 213714.

Observations.—Although the plant was collected in considerable quantity I have not been able to find any trace of ♂ or ♀, so am not able to say to which sub-genus of *Anthoceros* the species belongs. Mitten records only 4 species of *Anthoceros* from New Zealand, all very different from the above, and Stephani records 6 *Megaceros* and 3 *Anthoceros*, to none of which does this species agree according to his descriptions.

The plant has very much the appearance of an *Aneura*, to which genus I thought it belonged, but Lang, to whom I submitted specimens at once put me on the right track with some interesting information as to the Nostoc colonies.

In the collection I have been able to pick out only a few stems of two *Lejeuneae*, one probably *Eulejeunea* and the other *Microlejeunea*, neither of which I am able to refer to any described New Zealand species, but they are too few to publish safely as new.

Transmitted November 21, 1922.

EXPLANATION OF PLATES

PLATE 83

Marchantia Setchellii sp. nov.

(W. H. P., ad nat. del.)

Figs. 1 and 2. Frond, nat. size.

Fig. 3. Cross-section of frond, × 24.

Fig. 4. Cells near margin of frond, × 260.

Fig. 5. Median-scale, × 50.

Figs. 6, 7. Appendages, × 120.

Fig. 8. Mouth of stomata, × 260.

Fig. 9. Portion of fringe of cupule, × 120. (*Marchantia subandina* Spruce).

Fig. 10. Cross-section of frond, × 24.

Figs. 11, 12. Appendages, × 50.

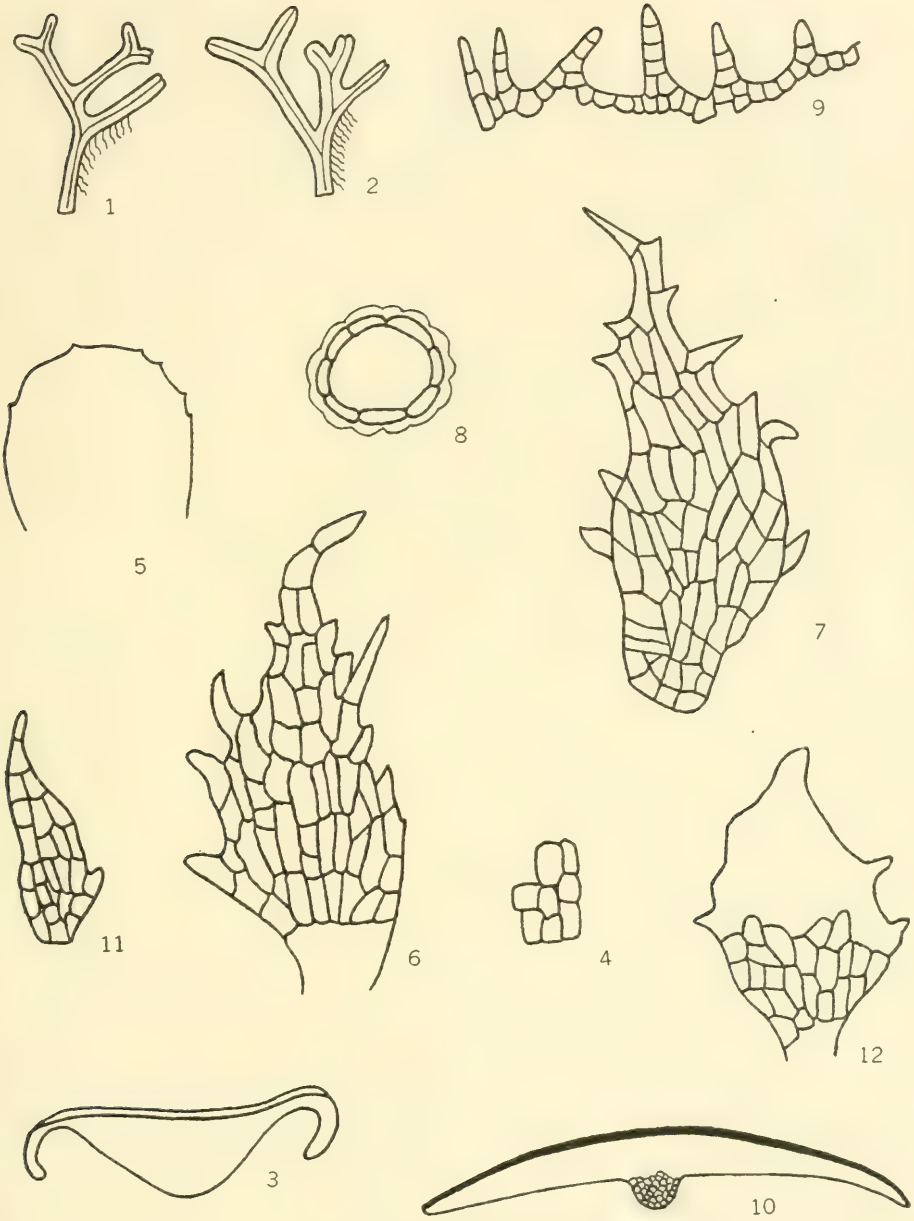
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PLATE 84

Riccardia marginata (Colenso) comb. nov.

(W. H. P., ad nat. del.)

Fig. 1. Fronds, nat. size.
Fig. 2. Portion of frond, × 16.
Fig. 3. Cross-section of chief stem, × 50.
Fig. 4. The same of branch, × 50.
Fig. 5. Marginal cells, × 260.
Fig. 6. Calyptra, × 24.
Fig. 7. Cross-section of same, × 50.
Fig. 8. Spores, × 260.

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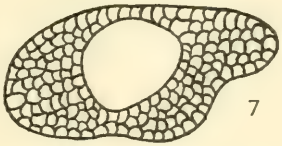

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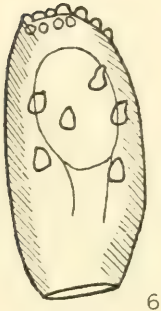

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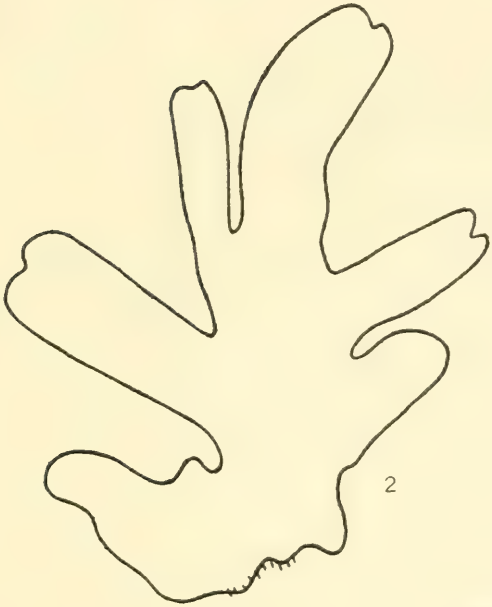

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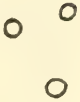

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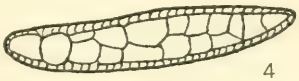

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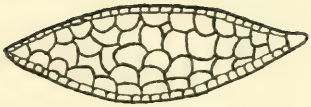

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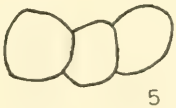

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PLATE 85

Riccardia bistrata sp. nov.

(W. H. P., ad nat. del.)

Fig. 1. Fronds, nat. size.

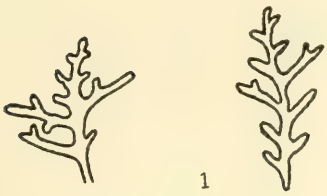
Fig. 2. Portion of frond, × 11.

Fig. 3. Cross-section of frond, × 120.

Fig. 4. Cross-section of young frond, × 24.

Fig. 5. Portion of frond, × 260.

Fig. 6. Young female involucre, × 50.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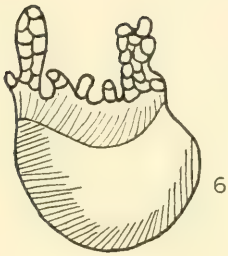
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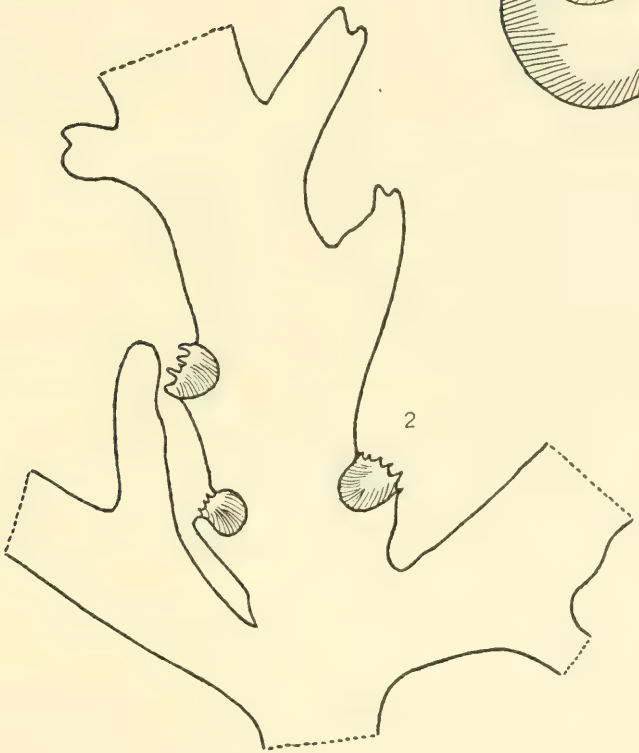
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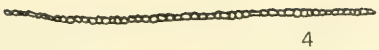
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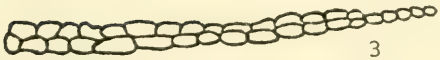
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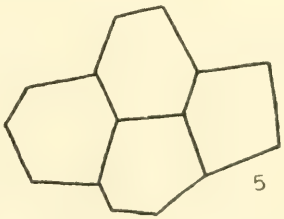
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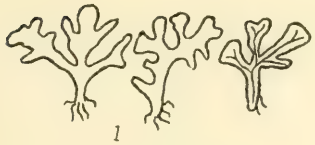
PLATE 86

Riccardia riccioides sp. nov.

(W. H. P., ad nat. del.)

Fig. 1. Fronds, nat. size.
Fig. 2. Portion of frond, × 11.
Fig. 3. Cross-section of rhizome, × 24.
Fig. 4. Cross-section of trunk, × 24.
Fig. 5. Cross-section of branch, × 24.
Fig. 6. Calyptra, × 16.
Fig. 7. Cross-section of calyptra, × 24.
Fig. 8. Portion of calyptra, showing papillae, × 50.
Fig. 9. Portion of trunk with male amentula, × 16.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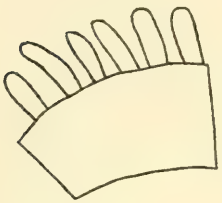
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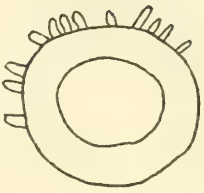
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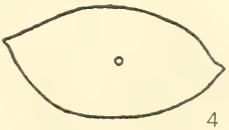
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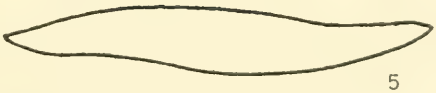
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PLATE 87

Symphyogyna microcalyptra sp. nov.

(W. H. P., ad nat. del.)

Fig. 1. Plants, nat. size.

Figs. 2, 3. Cross-sections of frond, × 24.

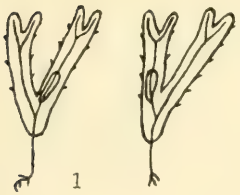
Fig. 4. The same, × 50.

Figs. 5, 6. Bracts from base of calyptra, × 24.

Fig. 7. Calyptra, × 24.

Figs. 8, 9. Appendages and archegonia from apex of calyptra, × 24.

Figs. 10, 11. Perigonial bracts, × 50.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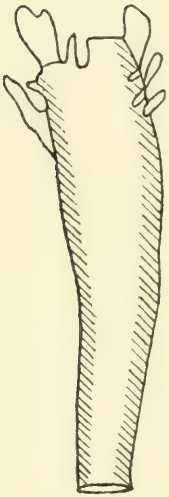
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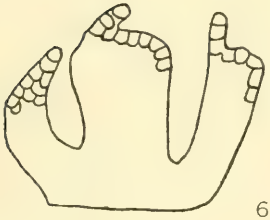
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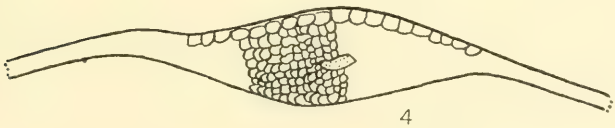
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PLATE 88

Solenostoma brevissimum sp. nov.

(W. H. P., ad nat. del.)

Fig. 1. Plants, nat. size.

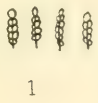
Figs. 2–8. Leaves, × 24.

Fig. 9. Portion of leaf, × 260.

Figs. 10, 11. Bracts, × 24.

Fig. 12. Perianth, × 24.

Figs. 13–15. Cross-sections of perianth, × 24.



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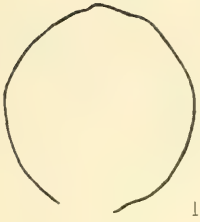

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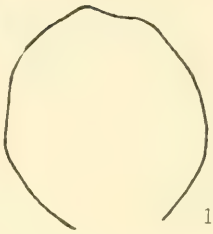

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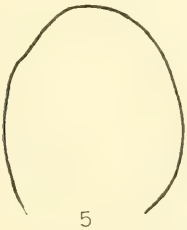

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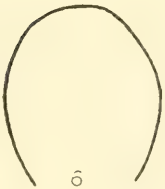

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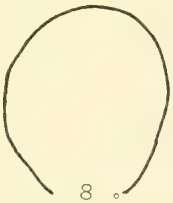

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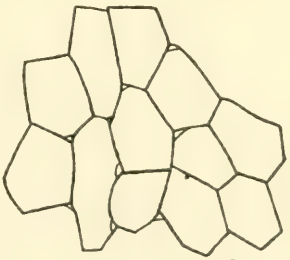

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PLATE 89

Plagiochila Kirkii Mitten

(W. H. P., ad nat. del.)

Figs. 1–4. Leaves, × 24.

Fig. 5. Bract, × 16.

Fig. 6. Perianth, × 16.

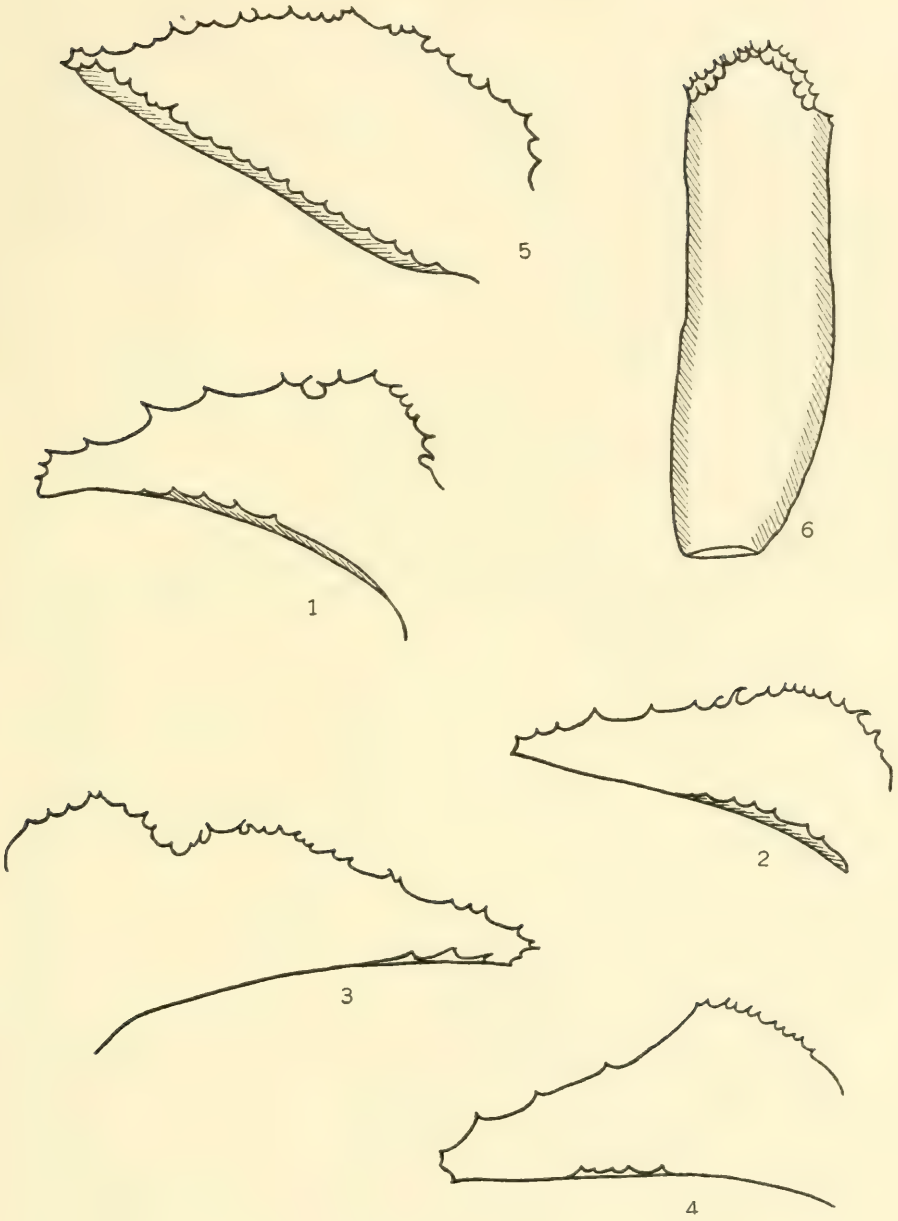
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PLATE 90

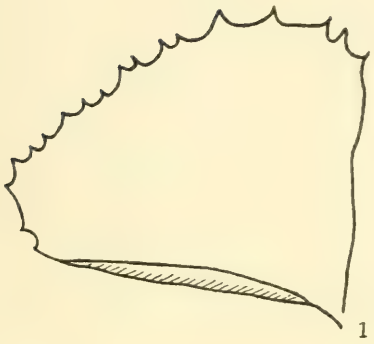
Plagiochila deltoidea Lindb.

(W. H. P., ad nat. del.)

Figs. 1–3. Leaves, × 16. (New Zealand, Setchell.)

Fig. 4. Portion of leaf near margin, × 260. (New Zealand, C. P. Smith.)

Fig. 5. The same near base, × 260. (New Zealand, C. P. Smith.)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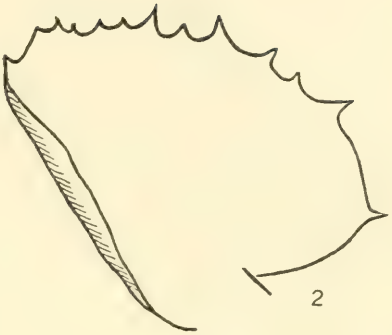
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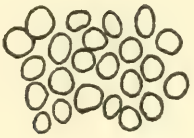
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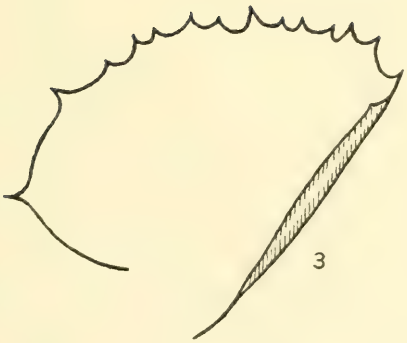
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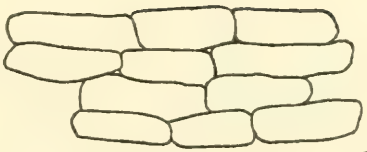
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PLATE 91

Plagiochila neohoweana Pearson

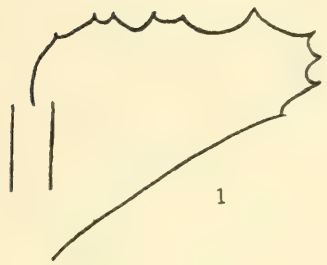
(W. H. P., ad nat. del.)

Figs. 1, 2. Leaves, × 16. (Weymouth, Tasm. Hep., 1566.)

Figs. 3, 4. The same, × 16. (Weymouth, Tasm. Hep., 1562.)

Fig. 5. Portion of leaf near margin, × 260.

Fig. 6. The same near base, × 260. (Tasmania, R. A. Bastow.)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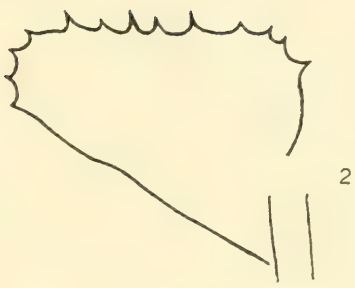
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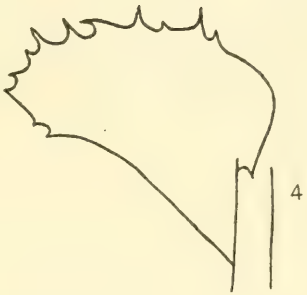
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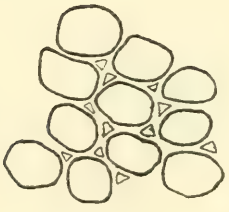
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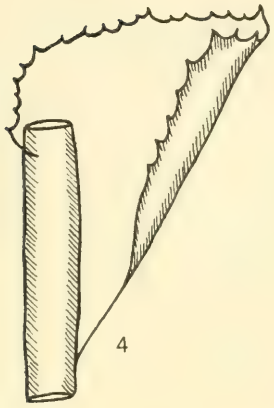
PLATE 92

Plagiochila arbuscula (Bridel) L. et L.

(W. H. P., ad nat. del.)

Figs. 1–4. Leaves, × 16.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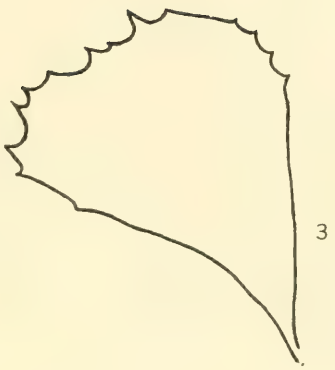
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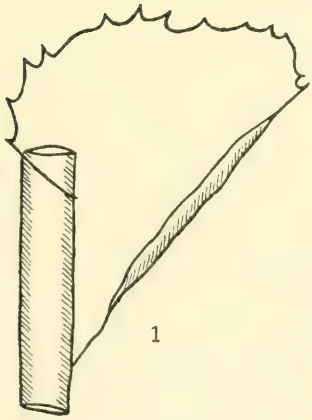
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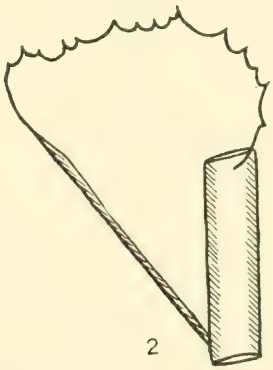
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PLATE 93

Lepidozia plumulosa Lehm. et. Lindb.

(W. H. P., ad nat. del.)

Fig. 1. Plant, nat. size.
Fig. 2. Cross-section of stem, × 50.
Figs. 3, 4. Leaves, × 50.
Fig. 5. Portion of leaf, × 260.
Figs. 6, 7. Underleaves, × 50.
Figs. 8, 9. Bracts, × 24.
Fig. 10. Sub-bract, × 24.
Fig. 11. Bracteole, × 24.
Fig. 12. Perianth, × 24.
Fig. 13. Cross-section of perianth, × 24.
Fig. 14. Setae from mouth of perianth, × 50.
Fig. 15. Archegonium, × 50.

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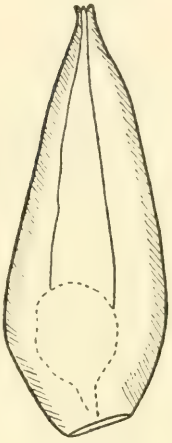
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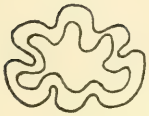
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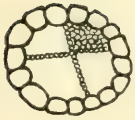
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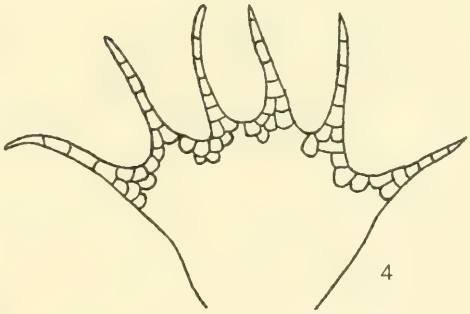
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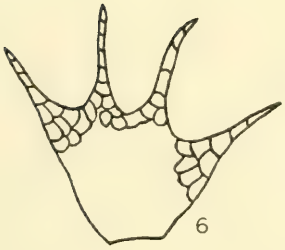
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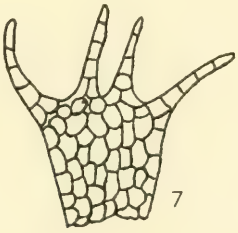
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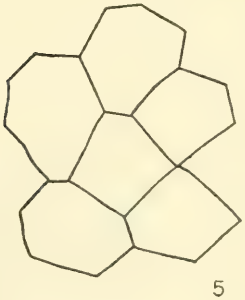
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PLATE 94

Lepidozia brevipinna sp. nov.

(W. H. P., ad nat. del.)

Fig. 1. Plants, nat. size.

Fig. 2. Portion of branch, × 50.

Figs. 3–7. Leaves, × 24.

Fig. 8. Portion of leaf, × 260.

Figs. 9–11. Underleaves, × 24.

Fig. 12. Perigonial bract, × 50.

Fig. 13. Perigonial bracteole, × 50.

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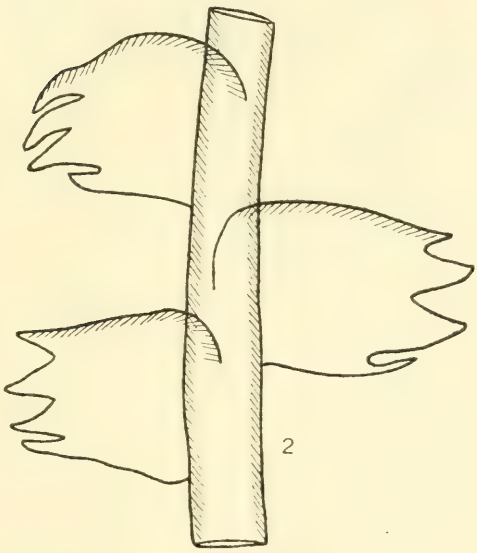
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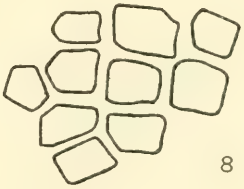
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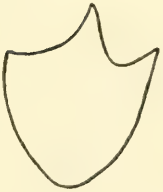
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PLATE 95

Isotachis minima sp. nov.

(W. H. P., ad nat. del.)

Fig. 1. Plants, nat. size.

Figs. 2–7. Leaves, × 24.

Fig. 8. Portion of leaf, × 260.

Figs. 9–13. Underleaves, × 24.

Figs. 14–17. Perigonial bracts, × 24.

Figs. 18–20. Perigonial bracteoles, × 24.

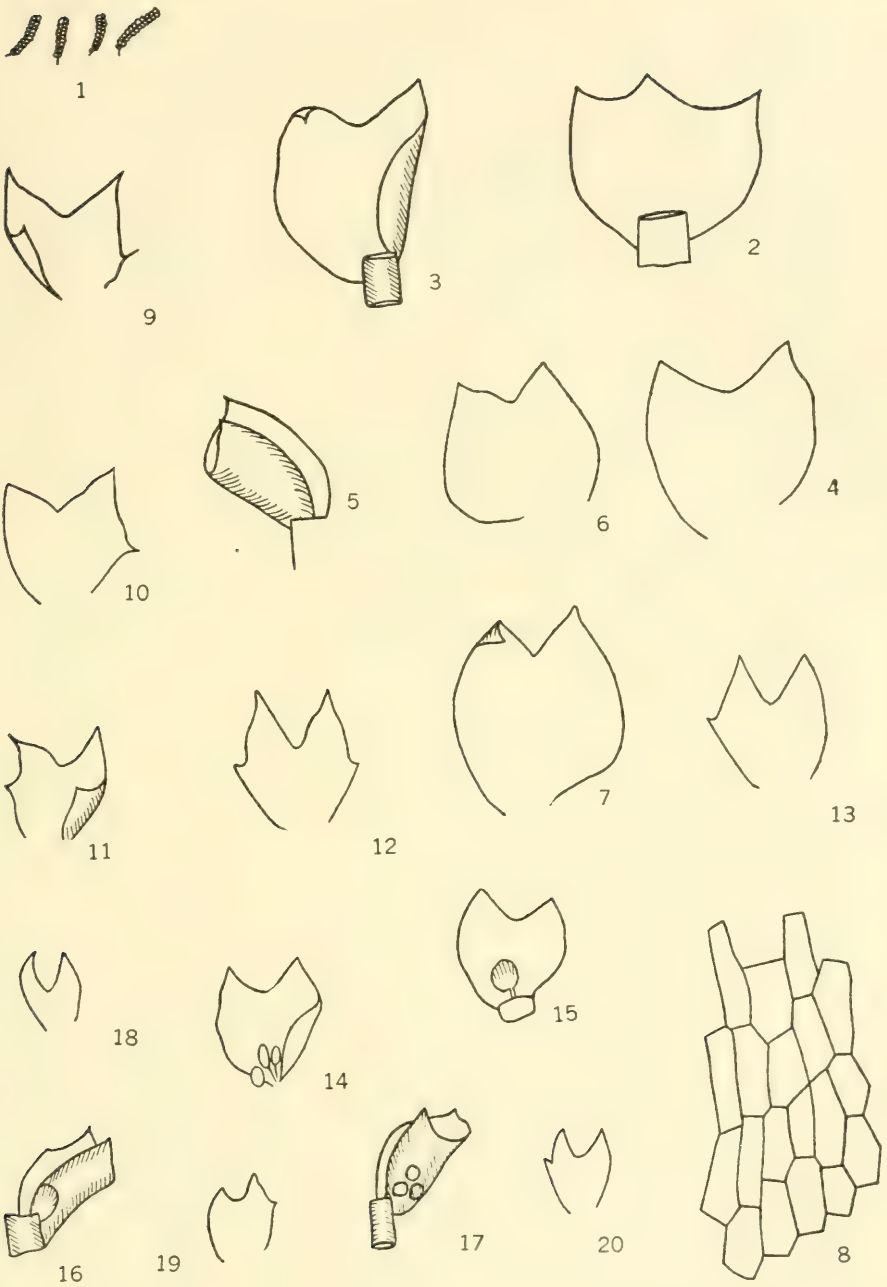
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PLATE 96

Radula plicata Mitten

(W. H. P., ad nat. del.)

Fig. 1. Portion of stem, antical view, × 24.

Figs. 2–6. Leaves, × 24.

Fig. 7. Leaf, × 50.

Figs. 8–10. Lobules, × 50.

Fig. 11. Perianth, × 24.

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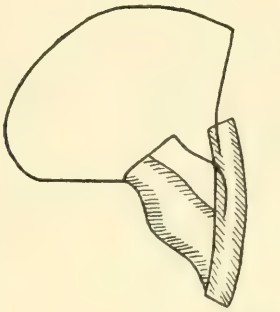

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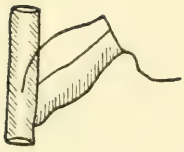

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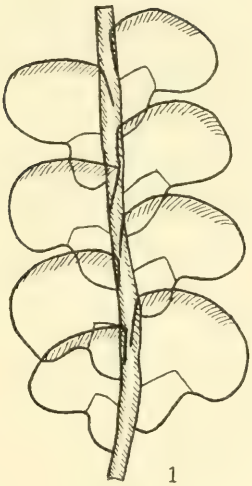

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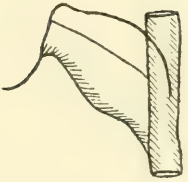

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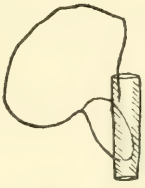

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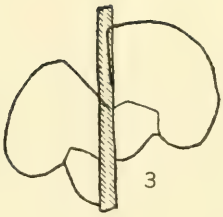

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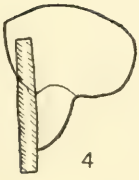

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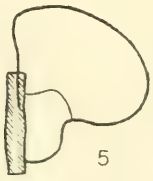

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PLATE 97

Radula physoloba Mont.

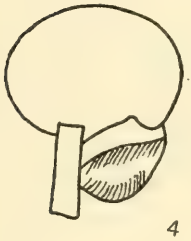
(Figs. 1–3, W. H. P., ad nat. del. Figs. 4–7, after Dismier.)

Fig. 1. Portion of branch, × 24.

Figs. 2, 3. Leaves, × 24.

Figs. 4, 5. Leaves.

Figs. 6, 7. Perianths (Insulis Auckland ad Stictam, Mont. Astrolabe Museum d'Hist. Nat. Paris).



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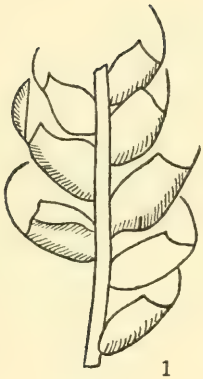

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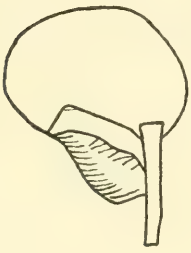

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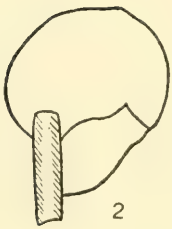

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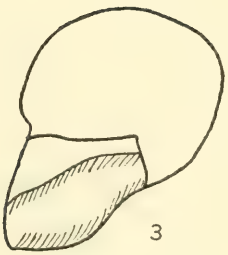

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PLATE 98

Radula flavifolia (Tayl.) Nees.

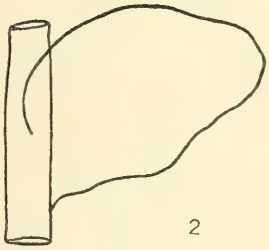
(W. H. P., ad nat. del.)

Fig. 1. Portion of branch, postical view, × 50.

Figs. 2–5. Leaves, × 50.

Fig. 6. Bract, × 50.

Fig. 7. Perianth, × 24. (Cape Horn, Herb. Taylor, Manchester Museum.)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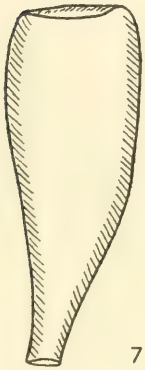
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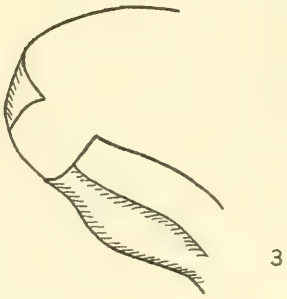
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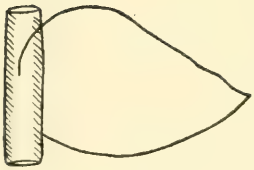
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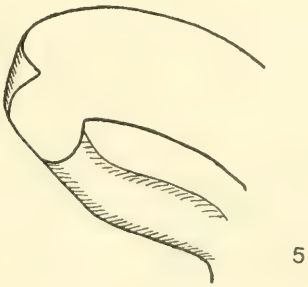
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PLATE 99

Frullania Colensoana St.

(W. H. P., ad nat. del.)

Fig. 1. Plant, nat. size.

Fig. 2. Portion of stem, antical view, × 24.

Fig. 3. The same, postical view, × 24.

Figs. 4–10. Leaves, × 24.

Fig. 11. Leaf, × 50.

Fig. 12. Portion of leaf, × 260.

Figs. 13, 14. Underleaves, × 24.

Fig. 15. Underleaf, × 50.

Figs. 16, 17. Perigonial bracts, × 50.

Fig. 18. Perigonial bracteole, × 50.

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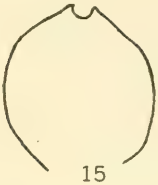
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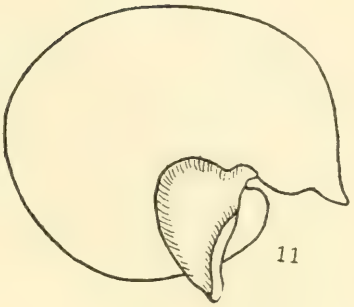
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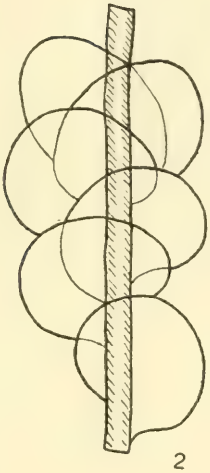
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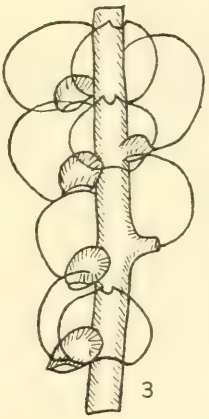
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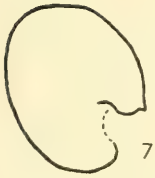
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PLATE 100

Frullania fugax Tayl.

(W. H. P., ad nat. del.)

Fig. 1. Plant, nat. size.

Fig. 2. Portion of stem, postical view, × 50.

Fig. 3. Portion of branch, postical view, × 50.

Figs. 4–6. Leaves, lobes, × 50.

Fig. 7. Leaf with gemmiparous branchlet, × 50.

Fig. 8. Lobule, × 50.

Fig. 9. Portion of leaf, × 260.

Figs. 10–12. Underleaves, × 50.

Figs. 13, 14. Bracts, × 50.

Figs. 15, 16. Bracteoles, × 50.

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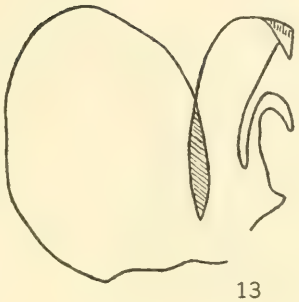
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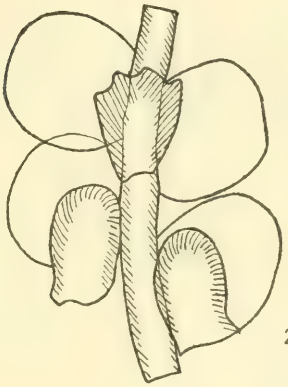
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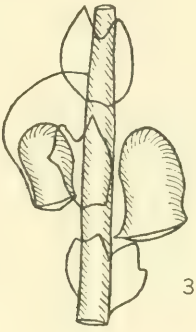
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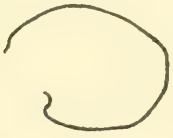
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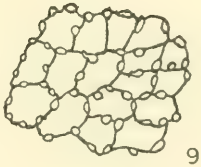
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PLATE 101

Frullania squarrulosa Hook. f. et Tayl.

(W. H. P., ad nat. del.)

Fig. 1. Plant, nat size.

Figs. 2–6. Leaves, × 24.

Fig. 7. Portion of leaf, × 260.

Figs. 8, 9. Underleaves, × 50.

Fig. 10. Bract, × 24.

Fig. 11. Bracteole, × 24.

Fig. 12. Perianth, × 24.

Fig. 13. Cross-section of perianth, × 24.

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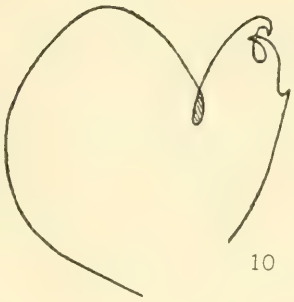
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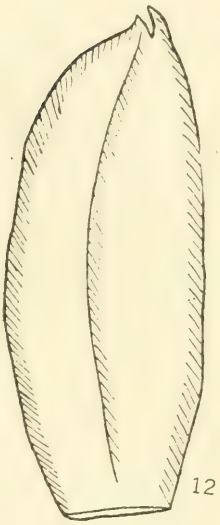
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PLATE 102

Frullania Setchellii sp. nov.

(W. H. P., ad nat. del.)

Fig. 1. Plant, nat. size.

Fig. 2. Portion of stem, postical view, × 50.

Figs. 3–6. Leaves, × 50.

Fig. 7. Lobules, × 50.

Fig. 8. Portion of leaf, × 260.

Figs. 9–12. Underleaves, × 50.

Fig. 13. Bract, × 50.

Fig. 14. Bracteole, × 50.

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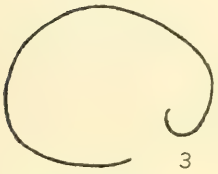
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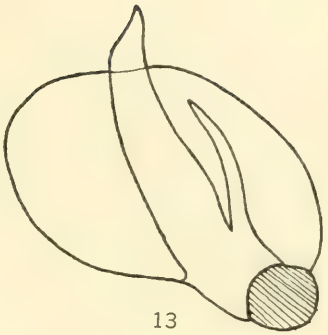
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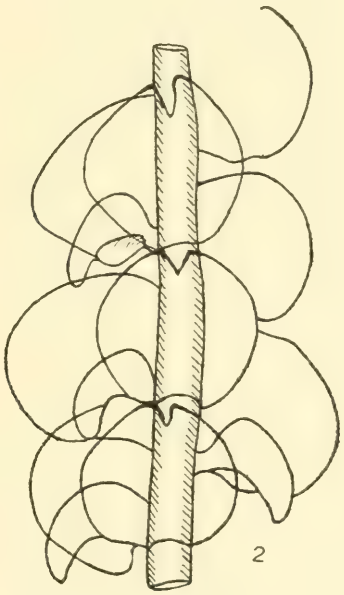
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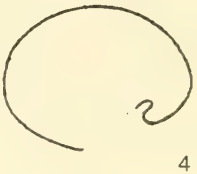
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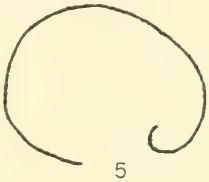
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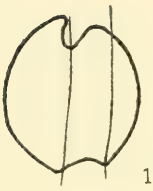
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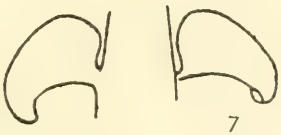
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PLATE 103

Anthoceros nostocoides sp. nov.

(W. H. P., ad nat. del.)

Figs. 1, 2. Plants nat. size.

Fig. 3. Portion of frond, × 11.

Fig. 4. Apex of frond, × 24.

Fig. 5. Cross-section of frond, × 24.

Fig. 6. The same, × 50.

Fig. 7. The same with Nostoc colony, × 24.

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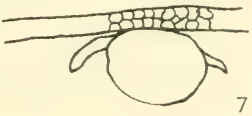
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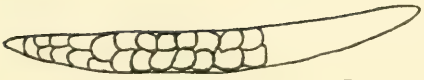
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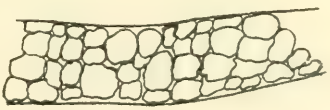
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MORE NEW ZEALAND HEPATICAE

BY

WILLIAM HENRY PEARSON

University of California Publications in Botany
Vol. 10, No. 5, pp. 373-392, plates 104-109
Issued June 9, 1923

MORE NEW ZEALAND HEPATICAE

BY

WILLIAM HENRY PEARSON

The following is a list of species, in a further collection from the North Island made by Professor W. A. Setchell in 1904, arranged according to Stephani's Species Hepaticarum.

Where the specimens could be divided, a set has been deposited in the Manchester Museum, in England, but the type specimens of the new species are deposited in the Herbarium of the University of California.

Aneura ..... ?

No ♂ or ♀. Specimen small and imperfect.

Habitat.—Taupo, May 15. No. 45.

Metzgeria chilensis St.

Observations.—Fronds small, narrow, more or less revolute; costa with 2 antical and 2 postical cells, setose; wings naked or sometimes setose; cells without trigones.

Stephani describes the wings as naked, but I find some setose.

Habitat.—Opepe, May 17. No. 53.

Pallavicinia Setchellii sp. nov.

Plate 104, figures 1–6

Dioicous; small to medium size, yellowish to brownish green in color; densely caespitose; stem firm, procumbent, radiculose; rhizoids abundant near the base, pale reddish brown in color, naked at and near base, then narrowly winged, afterwards abruptly dilated into a linear, narrowly oblong, or rarely suborbicular frond, simple or furcate at the apex, some wings connivant, others flat or slightly undulate; costa broad, plano-convex; cross-section of costa showing a central band of 50 broad and 10 thick, of minute cells, with 5 larger above and 5 below; wings 3 to 4 cells thick near the costa, gradually becoming thinner to the margin, where they are one cell thick; cells medium to rather large, quadrate, 4, 5, and 6-sided, walls thin; no trigones; margin distantly dentate-serrate, teeth hamate, 3 to 4 cells

wide at their base, 3 to 4 cells long; inflorescence antical ♀ arising from costa; involucre cup-shaped, laciniate, laciniae short, acute, numerous; archegonia long, narrow, reddish brown, 30; perianth young and imperfect. No ♂ seen.

Dimensions.—Plants 2 cm. long; fronds 8 mm. long × 4 mm. wide; costa, 75 mm. wide × .5 mm. thick; cells of wings .035 mm. to .045 mm.; marginal teeth .35 mm. long; involucre 2 mm. high × 1 mm. broad; archegonia .4 mm. long × .05 mm. wide.

Observations.—The only *Pallavicinia* from New Zealand with which to compare *P. Setchellii* is *P. connivens* (Colenso) St., which has, according to Stephani's description (Proc. Linn. Soc., p. 270, 1893), reniform or sub-circular fronds, which are repeatedly furcate, texture fleshy, marginal teeth straight, archegonia 6 to 8, with cells 0.025 mm. (Sp. Hep., p. 324, 1900). *P. Setchellii* has usually linear, more rarely sub-orbicular fronds, with firm texture, marginal teeth hamate, archegonia 30. Sterile forms of *Pallavicinia* may be mistaken for *Symphyogyna,* which genus has also an antical inflorescence, but as Stephani remarks (Proc. Linn Soc., p. 271, 1893), "The cylindrical involucre distinguishes *Pallavicinia* at once from *Symphyogyna,* the pistils of which are merely covered by a scale free at the sides and inserted on the frond by its base alone, so that it can be turned backwards without a rupture." I add a figure of bract of *Symphyogyna grandibracteata* St., a specimen of which I took occasion to compare with my plant.

Through the kindness of the Director of Kew, I have been able to see the original specimens of *Pallavicinia connivens* (Col.) St. The plant is much smaller, with a long stipe, which abruptly dilates into a radiate frond, margin with a few coarse teeth which might almost be called segments.

Habitat.—Taupo, May 16, 1904. No. 34. Type Herb. Univ. Calif., No. 213704.

Symphyogyna Hymenophyllum (Hooker) M. et N.

Syn. Hep., p. 480.

Habitat.—Pipiriki, May. No. 97.

Solenostoma brevissimum Pearson

Habitat.—Taupo, May 15. No. 45. Pipiriki, May. No. 98.

Lophocolea heterophylloides Nees

Habitat.—Whangerei, July 14. No. 52 with perianths and ♂. Taupo, May 16, No. 38; Taupo, May 15, No. 46; Island Bay, June 5, No. 42.

Observations, No. 38.—This is a very variable and difficult species to understand. Some forms seem so different from the type that one feels inclined to consider them as distinct, but the characters vary so much in the same tufts and even on the same plant that I have solved the difficulty by lumping them together.

Observations, No. 46.—This is a small male form with leaves entire, retuse or emarginate, and with underleaves free, bifid with exterior tooth on both sides.

Observations, No. 42.—The specimen represents a small, flaccid innovant form, with numerous involucres but no perianths. The involucres are compressed and that, along with the comparatively large patulous underleaves, gives it the appearance of a *Leioscyphus*. I add the notes I made on its examination.

Stem 1 cm. long, simple or rarely with a small branch, repeatedly innovant, 3 times; on a cross-section, stem broader than thick, somewhat angular, 15 cells by 10, cortical cells 30, similar to the inner; leaves broadly ovate, obtuse, rotundate, retuse or on the young branches bifid; cells small to smallish, quadrate, 4, 5 and 6-sided, walls thick, trigones very small; underleaves roundish-quadrate, bifid to about the middle, long tooth on exterior side of segments, segments acuminate, narrowly connate with one or both leaves, patulous, standing off from the stem; sub-bracts entire, often with a minute tooth at their base; bracts broadly ovate, entire, apex obtuse or rotundate; bracteole quinquedentate; perianth (young) with mouth laciniate; archegonia 20; perigonial bracts oval, ventricose.

Lophocolea heterophylloides Nees, var. **crassiflora** var nov.

Plate 105

Dioicous; medium size; yellowish green in color; stems slightly ramose; leaves oblong-obovate, entire or slightly retuse, upper leaves and sub-bracts with 1 or 2 minute teeth near the base, cells smallish small to smallish, quadrate, 4, 5 and 6-sided, walls firm, no trigones; underleaves large, roundish-quadrate, 6 or 7 segments, the two inner segments largest, lanceolate acuminate; bracts oblong, apex with few teeth or lacinae, with a large tooth near base; perianth large, firm, 3 or 4 cells thick near base, mouth laciniate.

Dimensions.—Stem 3 to 4 cm. long; with leaves 2 mm. wide; diam. of stem .3 mm.; leaves 2 mm. × 1.5 mm., 1.5 mm. × 1 mm., 1 mm. × .75 mm; cells .02 mm., .03 mm.; underleaves 1.25 mm. × .75 mm.,

segments. 75 mm., 1 mm. × 1 mm., seg. .5 mm.; bracts 3 mm. × 1.5 mm., bracteole 2 mm. × 1.5 mm., seg. .75 mm.; perianth 4 mm. × 2 mm.

Habitat.—Taupo, May. No. 49. Type Herb. Univ. Calif., No. 213703.

Observations.—For a time I was inclined to look upon this form as a distinct species, but, after repeated examination and comparison with all my other specimens of *L. heterophylloides*, I refer it as a variety under this species. The large, 6 and 7-toothed underleaves, the 1 or 2 minute teeth on the upper leaves and sub-bracts at their base, the large, firm perianths 3 to 4 cells thick near the base, seem to justify its separation, but the findings of young bifid leaves and the approach to its other characters in other specimens of *L. heterophylloides* induce me to consider it as only a variety of this variable species.

Lophocolea minuta n. sp.

Plate 106

Dioicous; small, yellowish green in color; terricolous; loosely caespitose; stem simple or rarely with a thin, short branch; cortical cells 30, similar in size to inner, which are 8 × 8; leaves spreading or secund, patent-divergent (70°) to patent (50°), distant or approximate, narrowly oblong or ovate, bifid to nearly the middle, segments lanceolate, acuminate, 8 cells wide at the base, 20 cells long, incurved or spreading, sinus rounded; antical margin slightly decurrent; postical margin extending to the middle of stem; cells smallish, quadrate or oblong-quadrate, walls firm, trigones small but distinct; underleaves free, moderately large, bipartite to two-thirds or three-fourths, disk broadly cuneate or broadly quadrate, segments lanceolate, acuminate, with an exterior segment on each side near the middle, about a third or fourth the length of the segment; bracts and sub-bracts larger than the leaves; bracts narrowly oval, bifid to nearly the middle, segments lanceolate, acuminate, with a small tooth on the exterior side of one segment; perianth large, oblong, obovate, trigonous, wingless, mouth wide, laciniate, laciniae 6 to 8, entire or slightly dentate; androecia intercalular on smaller and more delicate stems, 4 to 6 pairs of bracts, secund, closely imbricate, ventricose, bifid to about the middle, perigonial bracteole quadrate, bifid to the middle with small tooth on exterior side of each lanceolate segment.

Habitat.—Taupo, May 16. No. 48. Type Herb. Univ. Calif., No. 213702.

Dimensions.—Stem 1 cm. long; diam. of stem .1 mm.; with leaves 1 mm. wide; leaves .9 mm. × .45 mm., segments .35 mm., .8 mm. × .35 mm., seg. .4 mm., .75 mm. × .3 mm., seg. .35 mm.; cells .02 mm.; underleaves .5 mm. × .35 mm., seg. 35 mm., .475 mm × .25 mm., seg. .3 mm.; bracts 1.75 mm. × .6 mm., seg. .75 mm.; bracteole 1.25 mm. × .6 mm., seg. .6 mm.; perianth 2 mm. × .75 mm.; perigonial bract .4 mm. × .3 mm., seg. .2 mm.

Observations.—Mitten, in Handbook of the New Zealand Flora, reduces eight of Hooker and Taylor's small bifid-leaved *Lophocoleae* to three species. I have had the opportunity of examining these eight species, about which I hope to write later on, but *L. minuta* agrees with none of them.

Lophocolea minuta is one of the smallest perfectly developed species of the genus I have seen.

Lepidozia capilligera L. et L.

Lindenb. et Gottsche, p. 25, tab. IV.

Bracts oval, apex bidentate, with few minute teeth, perianth cylindrical, acuminate, mouth very small with few, short setae.

Habitat.—Opepe, May 17. No. 40 and No. 44.

Observations.—The narrow segments of the leaves (2 to 3 cells broad at base) with large cells induce me to refer these specimens to this species.

Lepidozia quadrifida L. et G.

Lindenb. et Gottsche, Sp. Hep.

Habitat.—Pipiriki, May. No. 98.

Lepidozia pendulina (Hook.)

Habitat.—Opepe, May 17. No. 40.

Lepidozia hippuroides Tayl.

Habitat.—Opepe, May 17. No. 44.

Observations.—Stephani says (Sp. Hep., vol. III, p. 595): "This species has been referred to *Lepidozia capillaris* (a Jamaica plant) to my amazement (by Mitten in Handbook New Zealand Flora, p. 523). The figure in the Antarctic Voyage is unfortunately quite misleading."

Lepidozia Novae Zealandiae St.

Dioicous; small, stems 2 cm. long, pinnate or bipinnate, flagelliferous; leaves not very deeply quadrified, segments 6 cells wide at base; cells small; underleaves broadly quadrate, quadrifid to the middle, 3 or 4 cells wide at base; perianths on short postical branches, very small, narrowly oblong, mouth constricted, with few short setae;

bracts broadly oval, sub-entire, slightly dentate or emarginate at apex; bracteole smaller, ovate, tri-quadridentate at apex; androecia on very short, postical branches; very small, subglobose, 2 pairs of perigonial bracts.

Habitat.—Opepe, May 17. Nos. 40 and 44. Taupo, May 16. No. 38.

Observations.—I have type specimens of this very distinct species. Neither ♂ nor ♀ is described by Stephani, but I have found both on Professor Setchell's specimens.

Frullania (Galeiloba) laciniaeflora sp. nov.

Dioicous; small, pale, greenish brown in color, intricately caespitose; stems irregularly ramose, branches spreading, pinnate or bipinnate, horizontally inserted, vaginate, imbricate, recurved or squarrose, oval, appendiculate, appendix rotundate; lobule small, galeate, sub-rotund, mouth wide, erect or slightly divergent from stem, often explanate, then lanceolate, obtuse; cells small, quadrate, 4, 5, or 6-sided, walls and angles thick, nodulose; underleaves large, three times broader than the stem, sub-orbicular, margin entire, bifid to one-fourth, segments triangular, acute, sinus acute; inflorescence on short branches, very numerous, usually imperfect; bracts with lobe broadly oval, apex rotundate or obtuse, lobule lanceolate, acute, unidentate on one side near the middle or entire; bracteole oblong-quadrate, bifid to the middle or below, slightly dentate, segments broadly lanceolate; perianth projecting about one-half beyond the bracts, broadly oval, tri-plicate, keels obtuse, densely covered with erect laciniae, beak short; spores brown, tuberculate, 15–20 on face. Androecia on more delicate and simpler stems, produced on short alternate branches, globose, 3 pairs of bracts, perigonial bracts, lobe semi-rotund, entire, apex obtuse, lobule broadly lanceolate, apex acute.

Habitat.—Kahikanui, near Whakapara, July 8. No. 50. Type Herb. Univ. Calif., No. 213701.

Dimensions.—Stems 2 cm. long; with leaves 1 mm. wide; diameter of stem .2 mm.; leaves, lobes .75 mm. × .6 mm., 85 mm. × .6 mm.; lobule .2 mm. × .15, explanate .2 mm. × .075 mm.; cells. 02 mm.; underleaves .5 mm. × .5 mm., segments .15 mm., .5 mm. × .45 mm., seg. .15 mm., .45 mm. × .45 mm., seg. .15 mm.; bracts, lobe .7 mm. × .6 mm., lobule .6 mm. × .3 mm.; bracteole .55 mm. × .4 mm., seg. .3 mm.; perianth 1.25 mm. × 1 mm.; valve of capsule .65 mm. × .325 mm.; spores .03 mm.; elaters .25 mm. long × .02 mm. wide; perigonial bract, lobe 5 mm. × .3 mm., lobule .45 mm. × .2 mm.; antheridia .15 mm. × .1 mm.

Observations.—There are two *Frullanias* recorded from New Zealand with hairy perianths; viz., *F. pycantha* Tayl. and *F. rostellata* Mitten. I have seen the original specimens of both and with neither of them does *F. laciniaeflora* agree. *F. pycantha* Tayl. is a much more robust species, stems 4 to 5 cm. long, reddish brown in color,

branches narrowly pinnate, leaves very squarrose, underleaves longer than broad. Stephani, in his description, Sp. Hep., says: "appendix subligulate, rotundate, connivent, lobule with large beak, underleaves small, only a little broader than the stem, broadly obcuneate, lobes apiculate; perianth obovate; bracts, lobe obovate-acute, lobule interior margin coarsely lacerate, bracteole coarsely spinose."

F. rostellata Mitten, of which the original specimen was kindly loaned to me by the Director of the Royal Botanical Gardens at Kew, has leaves concave, not squarrose; horizontally inserted, not vaginate, larger cells with large trigones, ovate-oblong (1 mm. × .65 mm); lobule very large, longly decurved, hooked with a long beak; and has underleaves with dentate margins; perianth obovate-oblong, laciniae much larger and longer, 6 cells long, with beak very long.

In *F. lacinaeflora,* the minute lacinae with which the perianth is clothed are unique, so far as observation goes. They are very minute and numerous. I counted more than a hundred on the antical side which are 3 cells long and 3 cells wide at their base, all pointing upwards. The spores are also very singular, being regularly and beautifully tuberculate and having on their face 15 to 20 little circular dots, which are more evident on the younger spores. The only capsule I saw was hyaline with a short seta.

Frullania (Galeiloba) obtusiloba sp. nov.

Plates 107 and 108

Sterile; small; pale brown in color; densely and intricately caespitose; stems irregularly ramose, branches bipinnate; leaves distant below, imbricate above, horizontally (90°) inserted, antical (upper) margin extending beyond the stem, broadly oval, apex rotundate, exappendiculate, gemmiparous, gemmae in small clusters on the margin, amorphous; cells minute, walls thick, nodulose, also at the angles; lobule galeate, mouth truncate, often explanate, then lanceolate; underleaves small, twice as broad as stem, orbicular or broadly oval, emarginate to about one-fourth, segments broad, obtuse or rotundate, sinus wide, rounded. No ♂ or ♀ seen.

Habitat.—Island Bay, June 5. No. 43. Type Herb. Univ. Calif., No. 213700.

Dimensions.—Stems 2 cm. long; diam. 1 mm.; with leaves .75 mm. wide; leaves, lobe .7 mm. × .55 mm., lobule .2 mm. × .125 mm.; cells .0125 mm.; underleaves .3 mm. × .3 mm., 25 mm. × .25 mm., .225 mm. × .3 mm., segments .075 mm.

Observations.—The only *Frullania* belonging to the *Galeiloba* section which has exappendiculate leaves is *F. decurvifolia* St., and

this differs from *F. obtusiloba* in having lobules as broad as high (.27 mm.), not broader than high (.2 mm. × .125 mm.); underleaves three times broader than the stem, not twice, obcuneate not orbicular; margin dentate on both sides, not entire; with segments subacute, not obtuse or rotundate. It is somewhat of a risk to found a new species on sterile Frullania plants, but the remarkable obtuse or rotundate segments of the underleaves enable the plant to be distinguished readily from any other.

Aspiromitus novazealandica sp. nov.

Plate 109

Monoicous; small, dark green in color, terricolous, densely caespitose; fronds solid, 10 cells thick at the middle, 50–60 cells wide, cortical cells dark, walls thick, inner cells hyaline, broadly cuneate, lobate, margins laciniate-dentate, crispate; cuticle tuberculate; involucre small and short, 5 cells thick near base, at mouth thin, lacerate; capsule reddish brown, stomatiferous; male alveoles adjacent to each other, crowded; antheridia solitary, large, stipitate, stipe 6 single cells long.

Habitat.—Taupo, May 16, 1904. Nos. 36 and 47. Types Herb. Univ. Calif., Nos. 213698, 213699.

Dimensions.—Fronds 1 cm. long and broad; lobes 3 to 4 mm. long, 2 mm. to 4 mm. broad, .75 mm. thick; involucres 1.5 mm. to 2.5 mm. long × .6 mm. to .75 mm. broad; capsule 3 cm. long; stomata .03 mm. × .02 mm.; antheridia .25 mm. × .225 mm.

Observations.—This is the first *Aspiromitus* recorded from New Zealand; it is remarkable for its small and short involucres and the crowded, large alveolas with large solitary antheridia.

The specimens were much overrun with *Solenostoma brevissimum* Pearson, making it difficult to make a satisfactory examination. Only young spores and elaters were observed.

PLATE 104

Pallavicinia Setchellii sp. nov.

Fig. 1. Plants, natural size.
Fig. 2. Frond, antical view. × 11.
Fig. 3. Cross-section of frond. × 24.
Fig. 4. Marginal tooth of frond. × 50.
Fig. 5. Portion of frond near margin. × 260.
Fig. 6. Involucre, explanate. × 24.

Symphyogyna grandibracteata St.

Fig. 7. Bract. × 24.

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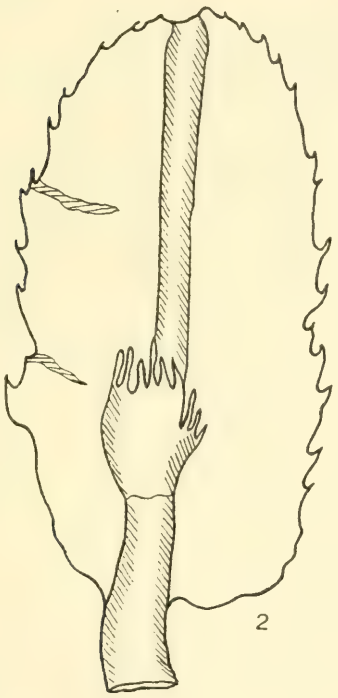

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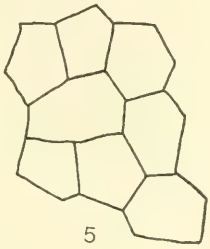

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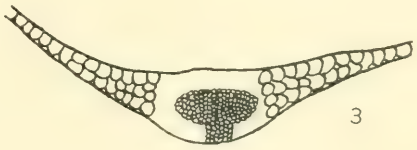

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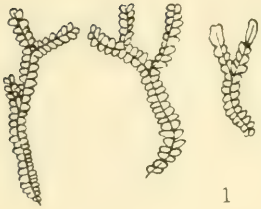
PLATE 105

Lophocolea heterophylloides var. *crassiflora* var. nov.

Fig. 1. Plants, natural size.
Fig. 2. Portion of branch, antical view. × 16.
Fig. 3. Portion of branch, postical view. × 24.
Figs. 4, 5. Leaves. × 24.
Fig. 6. Portion of leaf. × 260.
Figs. 7–9. Underleaves, × 24.
Figs. 10, 11. Bracts. × 11.
Fig. 12. Bracteole. × 11.
Fig. 13. Perianth. × 11.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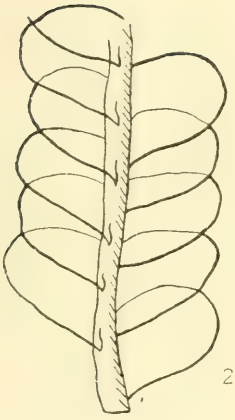
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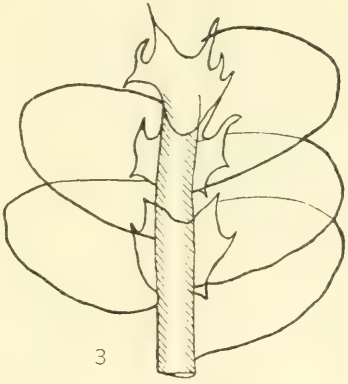
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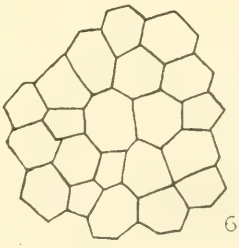
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PLATE 106

Lophocolea minuta sp. nov.

Fig. 1. Plants, natural size.
Fig. 2. Portion of stem, antical view. × 24.
Figs. 3, 4. Leaves. × 50.
Fig. 5. Portion of leaf. × 260.
Fig. 6, 7. Underleaves. × 50.
Fig. 8, 9. Bracts. × 24.
Fig. 10. Bracteole. × 24.
Fig. 11. Perianth. × 24.
Fig. 12. Perigonial bract. × 50.
Fig. 13. Perigonial bracteole. × 50.

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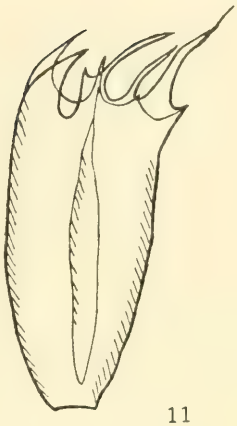

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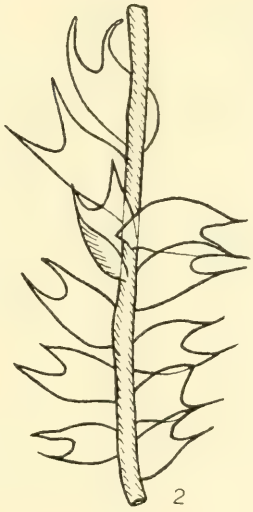

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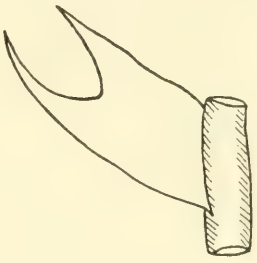

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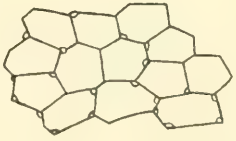

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PLATE 107

Frullania (Galeiloba) obtusiloba sp. nov.

Fig. 1. Plant, natural size.
Fig. 2. Portion of stem, antical view. × 24.
Fig. 3. Portion of stem, postical view. × 24.
Figs. 5, 6. Leaves. × 24.
Fig. 7. Portion of leaf. × 260.
Figs. 8–11. Underleaves. × 24.
Fig. 12. Underleaf. × 50.
Fig. 13. Bract. × 50.
Fig. 14. Bracteole. × 50.
Fig. 15. Perianth. ×24.
Fig. 16. Spore. × 260.
Fig. 17. Perigonial bract. × 50.

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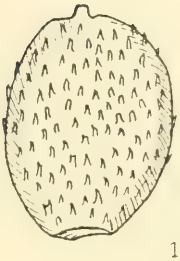
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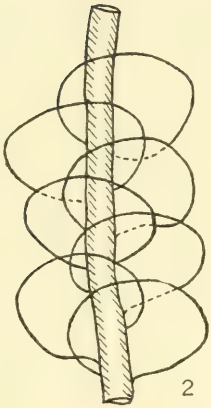
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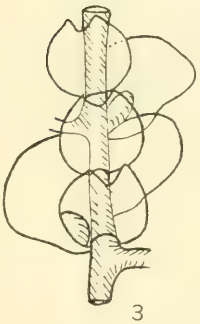
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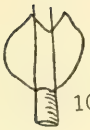
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PLATE 108

Frullania (Galeiloba) obtusifolia sp. nov.

Fig. 1. Plant, natural size.
Fig. 2. Portion of stem, antical view. × 50.
Fig. 3. Portion of stem, postical view. × 50.
Figs. 4, 5. Leaves. × 50.
Fig. 6. Portion of leaf. × 260.
Figs. 7–9. Underleaves. × 50.

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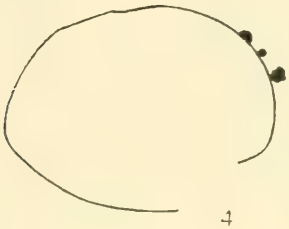

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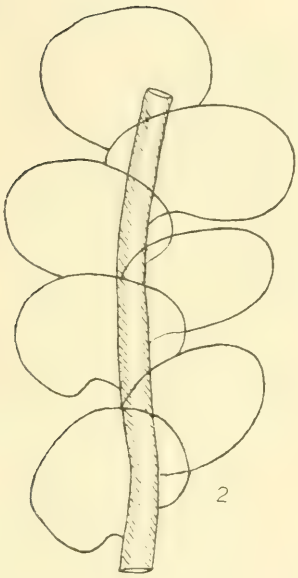

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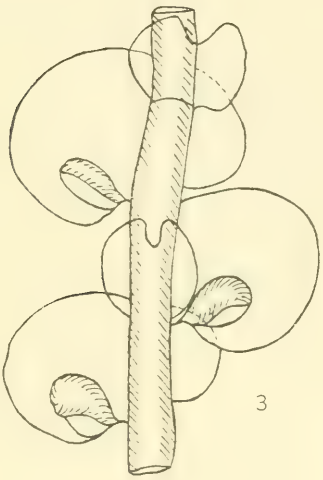

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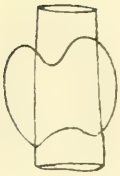

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PLATE 109

Aspiromitus novazelandica sp. nov.

Fig. 1. Plant, natural size.
Fig. 2. Portion of frond. × 11.
Fig. 3. Portion of frond, male. × 11.
Fig. 4. Cross-section of frond. × 16.
Fig. 5. Involucre. × 24.
Fig. 6. Cross-section of involucre, near base. × 24.
Fig. 7. Stomata on capsule wall. × 260.
Fig. 8. Antheridium. × 50.

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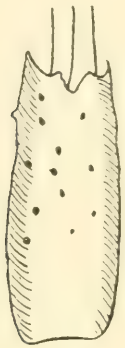
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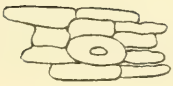
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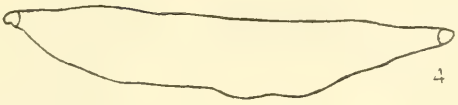
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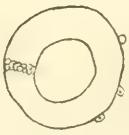
6

ERRATA

UNIVERSITY OF CALIFORNIA PUBLICATIONS IN BOTANY
Volume 10, Nos. 6 and 7

(SETCHELL, *Parasitic Florideae, II.*
SETCHELL, *A Revision of the West North American Species of Callophyllis.*)

Page 393, line 15. *For* albido *read* albidis.

Page 393, line 20. *For* carpostomi, *read* carpostomio.

Page 394, line 27.) Page 395, line 5.) *For* **Gonmiophyllum** *read* **Gonimophyllum.**

Page 394, line 31. *For* mentibus *read* nentibus.

Page 394, line 37.) Page 395, line 12.) For *Nitophyllum* read *Nitrophyllum.*

Page 399, line 15. *For* maximate *read* maxima.

Page 399, line 19. *For* systocarpic *read* cystocarpic.

Page 397. Under "Key" expand the first two lines to:

1. Cystocarps on terminal segments only 2
1. Cystocarps marginal (or on lateral lobes) only 4
1. Cystocarps largely on the 'disk' of the frond 9

700-9,'23

PARASITIC FLORIDEAE, II

BY

WILLIAM ALBERT SETCHELL

University of California Publications in Botany
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Issued May 24, 1923

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PARASITIC FLORIDEAE, II

BY

WILLIAM ALBERT SETCHELL

In 1914 (Univ. Calif. Pub. Bot., vol. 6, no. 1, pp. 1–34), pl. 1–6) I published what was intended to be the first of several papers on the floridean parasites, especially on floridean hosts. The publication of other species than those of *Janczewskia* has been delayed by pressure from other projects.

In 1918 (Proc. Am. Philos. Soc., vol. 57, pp. 155–172), I reviewed the progress made in our knowledge of the parasitism of the Red Algae and (pp. 165, 166) referred to certain unnamed species in my possession, but as yet unpublished.

It seems best, therefore, to publish the diagnosis of several new genera and species, awaiting the completion of the work of more thorough illustration and the drawing up of more complete descriptions, which are, however, in advanced preparation.

Gracilariophila Gardneri sp. nov.

Frondibus 3–3.5 mm. diam., albido, depresso-tuberculiformibus tetrasporiferis superficialiter laevigatis, cystocarpiferis superficialiter cum cystocarpiis mammillatis; tetrasporangiis per frondem totam, sub superficiem, regulariter sparsis, cruciatim divisis; cystocarpiis superficiem frondis totam tegentibus, proeminentibus, placentis exiguis, sporis catenatis, carpostomi apicali, pericarpio crasso, stratis cellularum numerosis, cellulis, internis majoribus, hyalinis, externis angustis, coloratis, in seriebus anticlinis ordinatis, superficialibus verticaliter elongatis, composito.

Parasitic on *Gracilaria Cunninghamii* J. Ag., near Santa Monica, California, January, 1913, N. L. Gardner, No. 2576.

Gracilariophila seems to be quite distinct from *Harveyella* (cf. however, Eddelbüttel. Bot. Zeit., vol. 60, p. 230, 1910) and *G. Gardneri* is a larger species than *G. oryzoides* Setch. and Wilson, with cystocarps projecting more conspicuously.

Faucheocolax gen. nov.

Genus Floridearum parasiticum in structura fructificationeque ad Faucheam arcte approximans; frondibus albidis aut albido-luteis, verrucaeformibus, parte basali solidis, ramos fertiles paucos aut numerosos emittentibus; tetrasporangiis cystocarpiisque et quoque structura frondis iisdem specierum Faucheae, sed frondibus parasiticis et decoloratis.

Faucheocolax attenuata sp. nov.

Frondibus circa 2 mm. diam.; ramis fertilibus brevibus simplicibus aut ramosis, tetrasporangiiferis basi plus minusve tumidis, supra attenuatis, cystocarpiiferis supra in cystocarpiis terminatis, tetrasporangiis cruciatis.

Parasitic on *Fauchea laciniata* J. Ag., Carmel Bay, California, May, 1915, N. L. Gardner, No. 2867.

This species is probably widespread on the Pacific coast of North America, but I quote, here, only the locality of the type.

Rhodymeniocolax gen. nov.

Genus Floridearum parasiticum in structura fructificationeque Rhodymeniam arcte approximans; frondibus minutis, e basi solidis, exiguis, hostam plane penetrantibus ramos curtos crassosque irregulares et indistincte ramulosos gerentibus, oriendis.

Rhodymeniocolax botryoidea sp. nov.

Frondibus circa 3 mm. latis; ramis usque ad 0.75 mm. altis; cystocarpiis terminalibus.

Parasitic on *Rhodymenia Palmetta?*, Whites Point, San Pedro, California, June, 1908, N. L. Gardner, No. 2067.

Gonmiophyllum Skottsbergii sp. nov.

Frondibus nanis, membranaceis, confertis, rosulatis, lobatis, plus minusve irregulariter laciniatis et cucullatis, usque ad 5 mm. latis, dilute rosea; tetrasporangiis polysporis massam globosam contimentibus, sporis radiatim positis, regulariter sparsis; cystocarpiis unilateraliter proeminentibus.

Parasitic on the stout basal portions of *Nitophyllum Ruprechtianum* J. Ag., at Lands End, San Francisco, California, December, 1905, W. A. Setchell, No. 6227.

This is a plant frequently found in rosettes at the base of the "stipe" of *Nitophyllum Ruprechtianum* J. Ag. all along the Pacific coast of North America. I have quoted only the type specimen since

more careful study of materials from other localities must be made. Unfortunately I have no material for careful comparison with *G. Buffhami* Batters. The polyspores are possibly a sufficient characteristic upon which to found a new genus. There are certain peculiarities of vegetative structure, also, tending away from Gonmiophyllum.

Polycoryne Gardneri sp. nov.

Frondibus in pulvinulo 2–3 mm. diam. aggregatis, albidis; ramis e centro communi exiguo solido radiantibus, tetrasporangiiferis usque ad 3 mm. longis nunc apice nunc medio tumidis, aut oblongis, cystocarpiferis curtis, usque ad 1 mm. longis, cystocarpiis in parte basali positis apice attenuatis acutisque.

Parasitic on *Nitophyllum Andersonianum* J. Ag., Point Cavallo, Marin County, California, October, 1913, N. L. Gardner, No. 2594.

This species, the second to be referred to the genus *Polycoryne*, is readily to be distinguished from *P. radiata* Skottsberg by the basal position of the cystocarp and the proportionally longer acute tip of the cystocarpic branchlet. *P. radiata* was detected at Maihafen in South Georgia Island in the Antarctic Ocean, parasitic on a species of *Nitrophyllum*, probably *N. polydactylum*.

Stromatocarpus Gardneri sp. nov.

Frondibus pulvinulos 2.5 mm. diam. formantibus, atropurpureis; filamentis basalibus et hostem penetrantibus monosiphoneis, dense confertis; filamentis superis liberis polysiphoneis, sparse ramosis, cellulis pericentralibus 4, tetrasporangiis in curtis, leviter tumidis stichidiis, in serie singulari, tripartitis; antheridiis oblongo-ellipsoideis; cystocarpiis magnis; pilis nullis.

Parasitic on *Pterosiphonia Baileyi* (Harv.) Falk., near Santa Monica, California, February, 1912, N. L. Gardner, No. 2475.

Our plant is much longer than *S. parasitica* Falk., has less swollen stichidia and antheridia and has the tetrasporangia in a single series in the stichidium. It has something more nearly approaching a solid base than is described for *S. parasitica*.

S. parasitica is cited from Cape Colony, South Africa.

Plocamiocolax gen. nov.

Genus Floridearum parasiticum in structura frondis et fructificatione Plocamium arcte approximans; frondibus minutis filiformibus e centro communi, solido, exiguosissimo radiantibus, albidis.

Plocamiocolax pulvinata, sp. nov.

Frondibus pulvinatis, usque ad 4 mm. latis, albidis aut albido-luteis; ramis usque ad 2.5 mm. longis, 0.25 mm. latis, sparse ramosis, rectis et sinuosis; tetrasporangiis in soris verrucosis, lateralibus, botryoideo-aggregatis; cystocarpiis terminalibus aut lateralibus, proeminentibus, carpostomium ostendentibus.

Parastic on *Plocamium coccineum*, Carmel Bay, California, May, 1915, N. L. Gardner, No. 2869.

A REVISION OF THE WEST NORTH AMERICAN SPECIES OF CALLOPHYLLIS

BY

WILLIAM ALBERT SETCHELL

A REVISION OF THE WEST NORTH AMERICAN SPECIES OF CALLOPHYLLIS

BY

WILLIAM ALBERT SETCHELL

The North American species of *Callophyllis* have never been revised, or even critically studied. Some years ago Dr. Olive Swezy, at the advice of the writer, made a critical study of our West Coast forms and the writer himself has since extended these observations. The greater number of the species referred to, or possibly referrable to, this genus have been examined and the following arrangement has been adopted.

This account is preliminary to a full discussion at some later date.

KEY TO THE SPECIES OF CALLOPHYLLIS OF THE PACIFIC COAST OF NORTH AMERICA

1. Cystocarps on terminal segments only 2
1. Cystocarps marginal (or on lateral lobes) only 9
2. Congested at the very tips, projecting ..... **C. acrocarpa**
2. Subterminal, on ultimate laciniae 3
3. Immersed ..... **C. flabellulata**
3. Projecting ..... **C. filicina**
4. On tips of lateral lobes ..... **C. odonthalioides**
4. Along the margins 5
5. Mostly projecting from the margins 6
5. Just within the margins 7
6. Frond over 400μ thick ..... **C. crassifolia**
6. Frond under 400μ thick ..... **C. marginifructa**
7. Margins of the frond finely crisped 8
7. Margins plane and entire ..... **C. Gardneri**
8. Cystocarps scattered ..... **C. stenophylla**
8. Cystocarps crowded ..... **C. Thompsonii**
9. Margins crisped, laciniate, or proliferous 10
9. Margins nearly or completely entire 11
10. Margins crisped ..... **C. crenulata**
10. Margins crowded with narrow, slender, compound laciniae ..... **C. plumosa**
10. Margins with regular, broad, stalked pinnules ..... **C. pinnata**
11. Frond dichotomous below, pinnate above 12
11. Frond dichotomous throughout 13
12. Fronds under 400μ thick, cystocarps small ..... **C. violacea**
12. Fronds over 600μ thick, cystocarps large ..... **C. megalocarpa**

13. Frond thin (under 200μ thick) ..... **C. heanophylla**
13. Frond medium thick (200–300μ thick) ..... **C. dissecta**
13. Frond thick (500–700μ thick) ..... **C. obtusifolia**

Callophyllis acrocarpa sp. nov.

Frondibus 3–5 cm. altis, laete rubris, complanatis, 5–6-plo dichotomo-pinnatis, inferne usque 6 mm. diam., supra angustis et acute laciniatis, angulis acutis praecipue supernis; cystocarpiis ad apices pinnularum ultimarum congestis, maxime proeminentibus; tetrasporangiis in pinnulus ultimis sparsis.

Santa Cruz, California, C. L. Anderson, Mrs. M. Tuttle, type, ♀ and + Herb. Univ. Calif., No. 150912; Santa Barbara, California, Mrs. S. P. Cooper.

Callophyllis filicina Setchell et Swezy sp. nov.

Frondibus 5–8 cm. altis, e disco communi gregariis, laete usque atro rubro, infra dichotomis, superne dichotomo pinnatis, praecipue opposito, alterne, aut secundato pinnatis (in fronde eadem), corymboso-complanatis, ramulis ultimis laciniato-dentatis aut lobatis, e basi ad apicem diametro constante; cystocarpiis segmenta ultima occupantibus, subterminalibus, maxime proeminentibus; tetrasporangiis ramulos supernos occupantibus.

Venice, California, N. L. Gardner, type ♀, no. 1913g; La Jolla, Mrs. M. S. Snyder, type +, Herb. Univ. Calif., no. 77819.

Callophyllis crassifolia Setchell et Swezy sp. nov.

Frondibus usque 12–13 cm. altis, obscure rubris, crassis carnosisque, e disco oriendis, inferne flabellatis, superne plus minusve pinnatis, pinnis ultimis laciniatis, segmentis in latitudine e basi ad apicem gradatim decrescentibus, omnibus plus minusve cuneatis; cystocarpiis definite marginalibus, seriatis aut sparsis, proeminentibus.

Pacific Grove, California, Mrs. J. M. Weeks, type ♀, Herb. Univ. Calif., no. 92800; Santa Cruz, California, C. L. Anderson.

Callophyllis marginifructa Setchell et Swezy sp. nov.

Frondibus gregariis, usque ad 12 cm. altis, saturate rubris, comparative tenuibus, membranaceisque, basi attenuatis et crassis, mox expansis, superne latis, complanatis, tenuibus, inferne flabellato-ramosis superne plus minusve dichotomo-pinnatis; cystocarpiis stricte in marginibus positis, vulgo seriatis, nunc sparsis aut inferne leviter intramarginalibus, proeminentibus.

San Pedro, California, Miss Mary T. Reynolds, type ♀, Herb. Univ. Calif., no. 92797. Apparently a frequently occurring plant on the coasts of central and southern California.

Callophyllis stenophylla sp. nov.

Frondibus usque ad 15 cm. altis, saturate rubris, membranaceo-chartaceis di-trichomoto-flabellatis; segmentis planis, modice latis (usque ad 7–8 mm.) superne dilatatis, cuneatis, ultimis rotundatis et plus minusve lobatis; marginibus serrulatis crispatisque; cystocarpiis in disco positis, sparsis, magnis, leviter proeminentibus.

Duxbury Reef, Bolinas, Marin Co., California, W. A. Setchell and M. B. Nichols, type ♀, Herb. Univ. Calif., no. 92766.

Callophyllis Thompsonii sp. nov.

Frondibus usque ad 20 cm. altis, saturate rubris, e disco parvo oriendis, infime in stipite cylindrica curta (1–7 mm. longis) contractis, mox in frondem late linearem basi plus minusve cordatam abrupte expansis, 3–5-plo dichotomo-flabellatis, lobis ultimis latis (0.5–1.5 cm.), rotundatis; cystocarpiis stricte seriatis intramarginalibus, pro maximate parte exigue proeminentibus; tetrasporangiis per segmenta supera sparsis.

Canoe Island, San Juan County, Washington, N. F. Thompson. Only two specimens were dredged off Canoe Island; fortunately one was systocarpic and the other tetrasporic. The types are in Herb. Univ. Calif.

Callophyllis Gardneri sp. nov.

Frondibus usque ad 8 cm. altis, saturate rubris, angustis, chartaceis, disco parvo binis aut ternis oriendis; stipitibus curtis (5–8 mm.) crassis, superne cuneato expansis et complanatis, repetite furcatis; ramis angustis (2–4 mm. latis), frondem segmentis numerosis angustis, ultimis pinnato-laciniatis et apicibus oblique truncatis formantibus; cystocarpiis marginalibus, sparsis aut in lobis frondis aggregatis, proeminentibus, longe rostratis; tetrasporangiis per segmenta superna sparsis.

Venice, California, N. L. Gardner, no. 2428; Redondo, California, Mrs. Thayer.

Callophyllis odonthalioides sp. nov.

Frondibus usque ad 12 cm. altis, saturate ad atro rubris, membranaceo-chartaceis, e disco parvo oriendis, segmento basali crasso, complanato, cuneato, curto (3–5 mm. alto), mox repetito furcatis; segmentis planis, 3–8 mm. latis, inferne dichotomis mox regulariter pinnatis, ramis in lobos curtos, rotundatos profunde fissis; cystocarpiis in lobis lateralibus aggregatis, plus minusve terminalibus, proeminentibus, rostratis.

Santa Cruz, California, C. L. Anderson, type ♀, no. 655; San Diego, California, Mrs. M. S. Snyder, type +, no. 656d.

Callophyllis crenulata sp. nov.

Frondibus usque ad 20 cm. altis, saturate rubris, paucis e disco communi parvo oriendis, latis, planis, segmentis infimis curtis, cuneatis, superne furcato-flabellatis, segmentis inferioribus curtis, late cuneatis, supernis latis (1.5–3 cm.), longisque, ultimis late lobatis, marginibus undulato-crispatis et irregulariter dentatis aut in pinnulas curtas, late et sparse lobatas prolongatis; cystocarpiis parvis moderate magnis (usque ad 1 mm. diam.), leviter proeminentibus, in disco frondis totae sparsis.

Whidbey Island, Washington, N. L. Gardner, type ♀ and +, Herb. Univ. Calif., no. 92775; Santa Cruz, California, Mrs. J. M. Weeks.

Callophyllis plumosa Setchell et Swezy sp. nov.

Frondibus usque ad 15 cm. altis, saturate rubris, planis, usque ad 1 cm. latis, membranaceo-chartaceis, uno aut paucis e disco communi parvo oriendis, segmentis infimis angustis crassisque, superne pinnatis, ramis paucis, elongatis, primo marginibus sparse dentatis, aetate provectiori pinnulis congestis, laciniate aut pinnulato ramosis obsitis; cystocarpiis magnis (usque ad 2 mm. diam.) in disco frondis laxe sparsis, leviter et unilateraliter proeminentibus.

La Jolla, California, Miss Minnie Reed, type ♀, Herb. Univ. Calif., no. 92773; San Pedro, California, Miss Mary T. Reynolds.

Callophyllis pinnata Setchell et Swezy sp. nov.

Frondibus usque ad 35 cm. altis, saturate ad atro rubris, latis (usque ad 4 cm.) planis, cartilagineo-membranaceis, paucis e disco communi oriendis, segmentis infimis late cuneatis, superne in segmentis longis latisque, vice semel aut bis profunde divisis, ultimis longis, obtusis aut apice late et obtuse lobatis, marginibus (in frondibus adultioribus) pinnulis magnis, late-lanceolatis aut ovatis, stipitatis aliquando segmenta principalia aequantibus obsitis; cystocarpiis in disco frondis totae sparsis, magnis (usque ad 3 mm. diam.) in superficie una leviter proeminentibus.

Fort Point, San Francisco, California, W. A. Setchell, M. A. Howe; Duxbury Reef, Bolinas, Marin Co., California, W. A. Setchell, type ♀, Herb. Univ. Calif., No. 92762, N. L. Gardner; Santa Cruz, California, C. L. Anderson. This is a coarse species with the likeness of *Rhodymenia palmata.*

Callophyllis megalocarpa Setchell et Swezy sp. nov.

Frondibus usque ad 25 cm. altis, saturate rubris, moderate latis (usque ad 2.5 cm.), stipitibus curtis, prope cylindricis e disco parvo oriendis, abrupte expansis complanatisque, segmentis curtis, admodum inferne dentatis aut proliferatis, superne dichotomo-pinnulatis et ad apicem veram crasse et laciniate fissis; cystocarpiis dense in disco dimidii superioris frondis sparsis, latis (usque ad 3 mm. et ultra latis.)

Carmel Bay, Monterey County, California, W. A. Setchell, type ♀, Herb. Univ. Calif., no. 92737. This coarse species occurs all along the California coast, recognizable at times with difficulty.

Callophyllis heanophylla sp. nov.

Frondibus usque ad 10 cm. altis, latis (usque ad 2 cm.), saturate rubris, papyraceo-membranaceis, paucis e disco communi parvo oriendis et in basem latam flabelliformen expansis, dichotomis frondem latem rotundatam formantibus, segmentis ultimis rotundato lobatis; cystocarpiis in disco superioris et mediae frondis sparsis, parvis (0.25–0.75 mm. latis), apiculatis.

Shaw Island, Washington, N. L. Gardner, no. 2291, type in Herb. Univ. Calif. The type specimens were dredged in some abundance from 5 to 30 fathoms of water.

Callophyllis dissecta Setchell et Swezy sp. nov.

Frondibus usque ad 16.5 cm. altis, angustis usque ad latis (1–3.5 cm.), saturate rubris, planis, moderate crassis, cartilagineo membranaceis, e disco parvo oriendis et abrupte in segmentum latum et flabelliforme expansis, dichotomo aut flabellato-ramosis, segmentis ultimis rotundato-lobatis; cystocarpiis in disco frondis sparsis, magnis (2–3 mm. latis).

San Pedro, California, Mrs. H. D. Johnston, type ♀, Herb. Univ. Calif., no. 92776.

PLANTAE MEXICANAE PURPUSIANAE, XII

BY

TOWNSHEND S. BRANDEGEE

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PLANTAE MEXICANAE PURPUSIANAE, XII

BY

TOWNSHEND S. BRANDEGEE

The collection from which these species are described was made by Dr. Purpus in 1923 in the states of Vera Cruz and Chiapas. The number of rare species and those belonging to other regions found in Mexico make this a very interesting collection. The locality printed in a former publication, No. XI, as Remulatero is an error and should have been Remudadero. I am under obligations to Dr. B. L. Robinson and Mr. I. M. Johnston, of the Gray Herbarium, for the comparison and determination of difficult species. Dr. A. S. Hitchcock, Mr. W. M. Maxon, Dr. S. F. Blake, and Dr. J. N. Rose also have obligingly identified many species belonging to orders or genera in which they are interested.

Callisia parvula sp. nov.

Caules ca. 2 cm. alti, ramosi, foliosi: foliis oblongo-lanceolatis usque 5 cm. longis, 5 mm. latis, margine prope basin hirtis, paulo ciliatis: pedunculis ramos terminantibus, 2–4 cm. longis, glabris, 1–3-floris; sepalis 3 ovato-acutis, 2 mm. longis; petalis 3 dilute purpureis sepala paulo superantibus, flabellatis; staminibus 2 filamentis dense barbatis, antheris oblongis, loculis contiguis; capsulis loculicide 3-valvis loculis 2-spermis, ellipsoideis, acutis; seminibus rugosis.

This is a small plant having grass-like leaves and growing in moist localities. Collected near Jalisco, Chiapas. No. 9202. Type, Herb. Univ. Calif. No. 220504.

Echeandia Purpusii sp. nov.

Glabra: foliis graminiformibus usque ad 15 cm. longis, 3 mm. latis, striatis; radicibus plerumque crassis: scapo ca. 25 cm. alto simplici vel parum ramoso: floribus ad quamque bracteam singulis; perianthii segmentis exterioribus lanceolatis 3-nerviis, ca. 5 mm. longis; interioribus latioribus albis; antheris connatis 5 mm. longis quam filamentis laevibus duplo longioribus; stylo haud exserto; pedicellis 6 mm. longis paulo infra medium articulatis: capsula 5 mm. longa.

Collected on rocky slopes near Hacienda Monserrate, Chiapas. No. 9155. Type, Herb. Univ. Calif. No. 220399.

NOV 11 1924

Pouzolzia Purpusii sp. nov.

Fruticulus monoicus: ramis brunneis junioribus pubescentibus: foliis alternis ovato-acuminatis basi cuneatis utrinque adpresse pubescentibus, ca. 1 cm. longis; stipulis lanceolatis ca. 5 mm. longis, deciduis: perigonio fructifero compresso margine alato, alis membranaceis ciliatis venosis; achaenio ovato-acuminato albo nitido.

The leaves of this species are not tomentose like those of *P. nivea* and *P. Pringlei*, and the species differs from other Mexican species in having the fruiting perigonium winged. Collected in rocky ravines of mountains near Hacienda Monserrate, Chiapas. No. 9206. Type, Herb. Univ. Calif. No. 220508.

Aristolochia oblongifolia sp. nov.

Caulibus puberulis striatis: foliis oblongis apice acutis basi 3-nerviis cuneatis vel breviter cordatis utrinque glabris, ca. 10 cm. longis, 4.3 cm. latis; petiolis ca. 5 mm. longis, puberulis: utriculo globoso diametro ca. 1.4 cm.; tubo ca. 8 mm. longo; limbo bilabiato labiis inaequalibus, labio superiori breviter apiculato: antheris 6; stylo apice 6-partito. Fructus ignotus.

The flowers of the specimen have fallen but they seem to have been racemose. Dr. Purpus notes that the bark is corky. Collected near Hacienda Monserrate, Chiapas. No. 9076. Type, Herb. Univ. Calif. No. 220393.

Coccoloba petrophila sp. nov.

Frutex parva, ramosa, ramis brunneis: foliis ovatis, utrinque glabris, coriaceis, supra viridibus, subtus pallidioribus, apice obtuse acuminatis, basi angustatis obtusis vel cuneatis, laminis 4–8 cm. longis, 1.5–3 cm. latis, venis subtus magis prominentibus; petiolis 0.5–1 cm. longis, ad basin ochrae insertis, quam ochreis brunneis 2–3-plo longioribus: inflorescentia solitaria ramos brevissimos terminanti vel axillari; spicis 4–7 cm. longis, quam foliis longioribus vel latioribus, nodulis 1–2-floris, pedicellis ca. 2 cm. longis, rachi breviter puberuli, pedunculo 3–9 cm. longo: perianthii tubo campanulato; lobis 5, ochroleucis; antheris exsertis, filamentis basi breviter connatis. Fructus ignotus.

Collected in a rocky arroyo near Cameron, Vera Cruz. No. 8872. Type, Herb. Univ. Calif. No. 218883.

Pisonia Purpusii sp. nov.

Frutex subscandens, ramis divaricatis glabris, interdum spinis paullo curvatis gerentibus: foliis oppositis vel ad apices ramulorum spinescentium fasciculatis, utrinque glabris, ovatis vel obovatis, sepius

ad basim angustatis, apice acutis vel obtusis, 3–5 cm. longis, 1.5–2.5 cm. latis; petiolis usque ad 1.8 cm. longis, supra canaliculatis: inflorescentia dioica axillari; mascula pedunculis brunneo-pubescentibus, ca. 2 cm. longis, ca. 30-floris; perianthiis campanulatis, brunneo-puberulis, lobis triangularibus; antheris exsertis; acanthiocarpiis ca. 1 cm. longis, glandulis stipitatis in seriebus duabus ad angulos singulos obsitis. Flores feminei desunt.

The position of the glands of the acanthocarpium in a double row at each angle is an important character separating the species from *P. capitata*, which it much resembles. The staminate plant was collected at Cameron, Vera Cruz, in 1923. No. 8869. The fruiting plant at the same locality without leaves was collected in 1922. No. 8739. Type, Herb. Univ. Calif. No. 218880.

Lonchocarpus fuscopurpureus sp. nov.

Frutex: ramis cinereis: foliis ca. 7 cm. longis, rhachibus paulo puberulis; foliolis 7–11, obovatis vel ellipticis, coriaceis, ca. 2.5 cm. longis, 1.5 cm. latis, inferioribus minoribus, apice plerumque emarginatis, supra glabris, subtus sub lente pubescentibus, pellucido-punctatis: racemis usque ad 5 cm. longis interdum 2–3-fasciculatis; pedunculis pubescentibus 1–2-floris; pedicellis brunneo-pubescentibus: floribus ca. 1 cm. longis; calyce cyathiformi, brunneo-pubescenti, breviter dentato; corolla atro-purpurea, vexillo emarginato, extus paululum pubescenti; stamine vexillari ima basi libero; ovario pubescenti, ca. 6-spermo. Fructus deest.

The leaflets vary in size and shape. When very young they are densely appressed hirsute, but in age they become apparently glabrous. The flowers, like those of *L. Purpusii*, are dark purple. Collected in a barranca near Remudadero, Vera Cruz. No. 8984. Type, Herb. Univ. Calif. No. 220292.

Machaerium chiapense sp. nov.

Undique glabrum, ramosum, foliosum: ramis verrucosis: foliorum rhachi 3 cm. longa; petiolo 2–2.5 cm. longo; foliolis 5–7, alternis, ovato-acuminatis, 2.8–3.8 cm. longis, 1.2–2.2 cm. latis; petiolulis 3 mm.–1 cm. longis: legumine axillari, recto, alam includenti 5–8 cm. longo; stipite ca. 8 mm. longo. Flores, bracteae, stipulae desunt.

The specimens are branches bearing only leaves and mature fruit. The leaves in drying have become dark colored. Collected along the road between Tuxtla Gutierrez and Jalisco, Chiapas. No. 9137. Type, Herb. Univ. Calif. No. 220440.

Tephrosia albida sp. nov.

Suffruticosa: caulibus erectis dense albo-sericeis, plus quam 3 dm. altis: rhachi foliorum crassa albo-sericea, ca. 3.5 cm. longa; foliolis 9–11, anguste oblongo-ovatis, basi cuneatis, apice obtusis vel retusis, supra glabris, subtus albo-sericeis, ca. 6 cm. longis, 1.4 cm. latis; petiolulis ca. 2 mm. longis; stipulis lanceolatis, 1 cm. longis, sericeis, deciduis: racemis terminalibus axillaribusque, ca. 12 cm. longis; florum pedicellis 2 mm. longis; calycis lobis lanceolatis, ca. 8 mm. longis, dense longo-sericeis; carina 1.1 cm. longa prope apicem valde incurva, pallide purpurea; vexillo glabro; stylo intus barbato: legumine immaturo 3 cm. longo, albo-sericeo, ca. 8-spermo.

Allied to *T. nitens* Benth. but differs from the illustration and description given, in the form and color of the corolla, and in the length of the pedicels; also, judging from the specimens, it is not a bush. Collected on rocks along the road from Tuxtla Gutierrez to Jalisco, Chiapas. The species is white with silky hairs, except on the upper surface of the leaves. No. 9136. Type, Herb. Univ. Calif. No. 222439.

Crotalaria monticola sp. nov.

Annua: caulibus erectis, usque ad 2 dm. altis, pilis adpressis patentibusque breviter hirsutis, longitudine tota patentim ramosis: foliis ternatis pedunclo hirsuto ca. 2.7 cm. longo; foliolis ovatis, acutis, 1–2 cm. longis, 0.8–1.7 cm. latis, utrinque adpresse pilosis: racemis 6–12 cm. longis; calyce hirsuto profunde lobato, 6 mm. alto; vexillo flavo quam calycis lobis dimidio longiori: legumine maturo 1.5 cm. longo, dense hirsuto, ca. 8-spermo.

This plant is very hirsute and the spreading branches give it a breadth equal to its height. Collected on high mountains near Hacienda Monserrate, Chiapas. No. 9133. Type, Herb. Univ. Calif. No. 220436.

Crotalaria chiapensis sp. nov.

Suffruticosa, erecta, ramosa: caulibus paulo pubescentibus plus quam 3 dm. altis: foliis ternatis, obovatis, acutis, basi cuneatis, subtus paululum adpresse breviter pilosis, supra glabris, 2–2.5 cm. longis, 4–7 mm. latis; pedunculis ca. 1 cm. longis; stipulis lineari-lanceolatis, ca. 1 mm. longis, deciduis: racemis usque ad 12 cm. longis, laxifloris; pedicellis 1–2 mm. longis, breviter adpresse pilosis, basi bractea iis breviori praeditis: carina ca. 8 mm. longa quam vexillo flavo pallidiori: legumine immaturo ca. 8-ovulato.

The stems and branches are erect. Collected on rocky plains near Buena Vista, Chiapas. No. 9130. Type, Herb. Univ. Calif. No. 220433.

Crotalaria quercetorum sp. nov.

Annua: caulibus prope basim patentim ramosis, adpresse breviterque hirsutis, 5–12 dm. longis: foliis simplicibus, lineari-oblongis, usque ad 6 cm. longis, 6 mm. latis, apice acutis, basi in petiolum ca. 2 mm. longum attenuatis, utrinque breviter adpresse hirsutis; stipulis nullis: lobis calycis lanceolatis, albo-hirsutis, ca. 7 mm. longis, quam corolla flava longioribus; racemis usque ad 4 cm. longis, 1–3-floris: legumine glabro, 2 cm. longo, pedicello 4 mm. longo.

This plant lacks the decurrent stipules and spreading yellow hairs of *C. sagittalis* L., a species the narrow leaved forms of which it somewhat resembles. Collected on high mountains among forests of pine and oaks near Hacienda Monserrate, Chiapas. No. 9144. Type, Herb. Univ. Calif. No. 220447.

Desmodium monticola sp. nov.

E radice lignosa decumbens: caulibus ca. 6 dm. longis, hirsutis: foliis ternatis; foliolis ovato-acuminatis, supra adpresse hirsutis, subtus hirsutis venis conspicuis; foliolo terminali ca. 3 cm. longo, 2 cm. lato, petiolulo 8 mm. longo; foliolis lateralibus minoribus: petiolo ca. 1.5 cm. longo, hirsuto: racemis uncinato-hirsutis, ca. 2.5 dm. longis, multifloris, pedicellis plerumque geminatis; bracteis brunneis striatis, lanceolatis, hirsutis, deciduis, ca. 5 mm. longis: leguminibus usque ad 1 cm. longis, 2–5-spermis, pendulis, uncinato-hirsutis, aequaliter sinuatis; articulis ellipticis. Flores desunt.

Allied to *D. mexicanum* Watson, but more hirsute with white hairs, and the raceme somewhat crowded with pendulous fruit and different form of leaf. Collected on high mountains near Hacienda Monserrate, Chiapas. No. 9134. Type, Herb. Univ. Calif. No. 220437.

Æschynomene chiapensis sp. nov.

E radice lignosa multicaulis: caulibus tenuibus striatis stricte ramosis: foliis petiolum 3 mm. longum includentibus usque ad 5.5 cm. longis; foliolis 31–61 oblongis apiculatis glabris 3 mm. longis; stipulis late lanceolatis striatis 2–3 mm. longis: racemis caules ramosque terminantibus 8–12 cm. longis, laxifloris; pedicellis 5 mm. longis; calycis lobis 4 ovatis ciliatis superiore lanceolato latiorique; petalis flavis purpureo-lineatis; carina valde incurva: leguminis articulis 1–3 glabris semilunatis sutura semenifera fere rectis; stipite 2 mm. longo.

The plants grow in clumps from thick woody roots. Collected near Hacienda Monserrate, Chiapas. No. 9147. Type, Herb. Univ. Calif. No. 220376.

Æschynomene arenicola sp. nov.

Annua: prope basim ramosis; caulibus usque ad 3 dm. altis, patentim hirsutis hirtis flavescentibus: foliis 2–2.5 cm. longis petiolum 2 mm. longum includentibus; rhachi hirsuta; foliolis 5–7-jugis oblongis congestis supra glabris subtus adpresse hirsutis, margine plerumque ciliatis, apice apiculatis, medio costatis, ca. 7 mm. longis, 4 mm. latis; stipulis lanceolatis hirsutis ca. 3 mm. longis: floribus racemis 2–3-floris axillaribus dispositis, ca. 3 mm. longis; pedunculis pedicellisque patentim hirsutis, pedicellis 4 mm. longis; calyce hirsuto; corolla ca. 4 mm. longa, flava purpureo-tinctaque; legumine ca. 1.5 cm. longo; articulis 5–8 utrinque fere aequaliter sinuatis, orbicularibus ca. 2 mm. latis; stipite 4–5 mm. longo.

An annual hirsute species having a slender legume with a long stipe. Collected on sandy soil in pine forests near Hacienda Monserrate, Chiapas. No. 9148. Type, Herb. Univ. Calif. No. 220377.

Æschynomene pinetorum sp. nov.

E radice lignosa crassaque multicaulis: caulibus erectis tenuibus glabris striatis paulo ramosis, ca. 3.5 dm. altis; rhachi foliorum ca. 2.5 cm. longa; foliolis plus quam 25 oblongis, 4 mm. longo; stipulis lanceolatis striatis hirtellis: inflorescentiis caules ramosque terminantibus; pedicellis ca. 1.8 cm. longis, hirtellis; corolla flava purpureo-tinctaque: legumine plerumque 1 cm. longo, articulis 2 glabris ellipsoideis terminali longe acuminato, isthmo fere centrali lato.

The specimens are old, and most of the leaflets and flowers have fallen. The numerous slender erect stems and short branches give the plant a broom-like appearance. Purpus No. 6625, distributed as *Æ. simulans* Rose, is the same species. Collected in pine forests near Hacienda Monserrate, Chiapas. No. 9064. Type, Herb. Univ. Calif. No. 220371.

Petalostemon chiapense sp. nov.

Fruticosum, erectum, ramosum, foliosum: caulibus ramisque pubescentibus praecipue superne: foliis ca. 1 cm. longis, utrinque albo-pubescentibus; stipulis lanceolatis, ca. 3 mm. longis; foliolis 5–7 ovato-oblongis, ca. 6 mm. longis, apice acutis, truncatis, vel retusis; stipellis minutis: spicis caules ramosque axillares breves terminantibus, densifloris, ca. 1.5 cm. longis: calycis lobis 1–1.5 mm. longis, quam tubo paulo brevioribus; petalis albis; vexillo cordato: ovario apice albo-hirsuto; bracteis 4 mm. longis, e basi lata filiformibus flores superantibus.

The flowering spikes, mainly terminating short axillary branches, are numerous. The pubescence of the stems, branches, and leaves gives the species a white appearance. Collected on mountains near Hacienda Monserrate, Chiapas. No. 9142. Type, Herb. Univ. Calif. No. 220445.

Stylosanthes eciliata Blake, sp. nov.

Herbacea perennis pluricaulis; caules suberecti (?) parce ramosi breviter pilosi (pilis laxis albis saepius adscendentibus) et dense hirsuto-setosi (pilis patentibus flavicantibus 2 mm. longis basi vix incrassatis); folia 3-foliolata internodiis saepe breviora; vaginae stipularum 4–5.5 mm. longae ut in caule pubescentes purpureo-tinctae, dentibus anguste subulatis curvato-patentibus hirsuto-setosis ca. 4 mm. longis; petioli similiter pubescentes 3.5–6 mm. longi, rachide 1.5–2 mm. longa; foliola brevissime petiolulata anguste elliptica 1.2–2.1 cm. longa 2–5.5 mm. lata acuminata cuspidulata basi rotundata integra firma pallide viridia supra praecipue ad costam sparse pilosula subtus in costa sparse hirsuto-setosa interdum in pagina sparse pubescentia margine laxe piloso-ciliata (pilis albis flaccidis), costa et venis (3–4-jugis, nervam submarginalem formantibus) supra impressis subtus prominulis; spicae axillares et terminales anguste oblongae ca. 8 mm. longae dense ca. 6-florae hirsuto-setosae; bracteae primariae 1-foliolatae, vaginis oblongo-ovatis ca. 3.5 mm. longis hirsuto-setosis et pilosulo-ciliatis, dentibus ca. 2.5 mm. longis, foliolo lineari-elliptico 3–4 mm. longo; bracta secondaria 1 ovata abrupte acuminata piloso-ciliata et intus pilosa 5 mm. longa, seta 2.5 mm. longa terminata; seta plumosa nulla; bracteola 1, bracteae secondariae simillima sed paullo minor et apice non longe setosa; calyx 7 mm. longus (basi stipitiformi 3–3.8 mm. longa inclusa), dentibus ad apicem ciliatis, dente infimo paullo longiore; vexillum flavum ca. 5 mm. longum; articulus fructus inferior sterilis minimus ca. 0.5 mm. longus apice pubescens, superior fertilis quadrato-ovalis paullum obliquus supra late rotundatus 2.2–2.6 mm. longus 1.8–2 mm. latus compressus in utroque latere 2-nervius et laxe reticulatus sparse sessili-glandularis, stylo sublaterali debili incurvo 0.3–0.4 mm. longo.

Type in the U. S. National Herbarium, No. 1,114,896, collected in pine forests at Hacienda Monserrate, Chiapas, September, 1923; Purpus No. 9246. Closely related to *S. purpurata* Blake, of Jalisco, which has the leaflets conspicuously pilose-setose on the margin, and fruit with a terminal style. In *S. eciliata* the leaflets are weakly pilose-ciliate, and the style is borne slightly below the level of the rounded highest point of the fruit, so that it appears to be lateral.

Mascagnia polycarpa sp. nov.

Frutex scandens: caulibus brunneis glabris: foliis oblongo-ovatis, oppositis, glabris, apice obtuse acutis, basi cuneatis, usque ad 12 cm. longis, 5 cm. latis, interdum basi glandulis duabus praeditis; petiolis puberulis, ca. 1.3 cm. longis: paniculis ca. 7 cm. longis; carpellis paulo pubescentibus: samarum alis lateralibus flabelliformibus, venosis, margine undulatis, ca. 1 cm. latis; ala dorsali e apice carpelli ad basim affixa, superne auriculata, ca. 3 mm. lata. Flores desunt.

The specimens are very mature and most of the fruit has fallen. Of the three carpels of each ovary, only one seems to have developed. Undeveloped fruit having three styles is abundant, scattered in the panicle. Collected at Remudadero, Vera Cruz. No. 9019. Type, Herb. Univ. Calif. No. 220319.

Banisteria nemorum sp. nov.

Fruticosa: ramis glabris: foliis ovatis, acutis, utrinque glabris, 8 cm. longis, 5 cm. latis, eglandulosis; petiolis 8 mm. longis: inflorescentia terminali, paniculata; sepalis ovatis, acutis 3 mm. longis quam glandulis 8 duplo longioribus; samaris 2.5 cm. longis, nuculis exappendulatis; alis breviter pubescentibus prope apicem 1.7 cm. latis, exauriculatis, dilute roseis. Flores desunt.

Collected in open forests near Jalisco, Chiapas. No. 9185. Type, Herb. Univ. Calif. No. 220486.

Bunchosia monticola sp. nov.

Frutex glaber cortice brunneis: foliis ovato-lanceolatis, basi in petiolum angustatis, 6–10 cm. longis, 2–3 cm. latis; petiolis ca. 7 mm. longis, puberulis: racemis ca. 7 cm. longis, 10–15-floris; pedicellis 1.3 cm. longis prope basim articulatis bracteolatisque; glandulis calycis 8 fere aequalibus; petalis calycem paulo superantibus, margine ciliatis ut videtur pallide flavis; stigmate capitato: fructu juveni pubescenti 3-loculari.

The large glands of the calyx and the small petals characterize this species. Not enough was collected for distribution. A single gland is often present near the base of the leaf blade. Collected on high mountains near Hacienda Monserrate, Chiapas. No. 9263. Type, Herb. Univ. Calif. No. 223436.

Picrasma mexicana sp. nov.

Frutex: ramis brunneis: foliis 25 cm. longis; foliolis 9–11, usque ad 10 cm. longis, 4 cm. latis, ovato-acuminatis, utrinque glabris, margine integris: paniculis cymosis, 5–8-floris; pedunculis 3–4 cm. longis, adpresse brunneo-pilosis; pedicellis brunneo-pubescentibus: sepalis oblongis, brunneo-pubescentibus: ovario 4-partito: stylis quam petalis longioribus: drupis 1–4 globosis.

Collected at Remudadero, Vera Cruz. No. 8800. Type, Herb. Univ. Calif. No. 211913.

Acalypha chiapensis sp. nov.

Frutex monoicus: caulibus ramisque interne glabris superne paulo pubescentibus: foliis ovato-acuminatis basi trinerviis utrinque pilis paucis praeditis, juvenibus primum pilosis, margine serratis, 4–7 cm. longis, 2.5–4 cm. latis; petiolis foliorum inferiorum usque ad 2.5 cm. longis, glabris vel hirsutulis, foliorum superiorum brevibus magis hirsutis; stipulis setaceis 5 mm. longis: inflorescentia mascula axillari usque ad 4.5 cm. longa pedunculum 2 cm. longum includenti, multiflori, bracteis ovato-acuminatis, 1.5 mm. longis, hirsuto-ciliatis; inflorescentia feminea axillari ca. 5 cm. longa pedunculum 3–4 cm. longum includenti, 1–4-floris, bracteis 7–9-lobis piloso-ciliatis; capsula pilosa.

Near *A. unibracteata*, differing in the much larger leaves and more numerous larger pilose bracts of the pistillate flowers. The older leaves lacking pubescence have a lustrous appearance. Collected between Tuxtla Gutierrez and Jalisco, Chiapas. No. 9171. Type, Herb. Univ. Calif. No. 220417.

Acalypha unibracteata Mull. Arg. var. **heterantha** var. nov.

Puberula: ramis interdum spicis ca. 3.5 cm. longis, laxifloris, floris femineis sessilibus terminantibus.

The axillary flowers on long pedicels are similar to those of the usual form of the species. Stems bearing terminal spikes are not common. Collected in fields near Mata Zarza, Vera Cruz. No. 9047. Type, Herb. Univ. Calif. No. 220340.

Pedilanthus petraeus sp. nov.

Ramis glabris; internodiis ca. 3.5 cm. longis: foliis deficientibus (delapsis?): floribus ad nodos secus ramulos dispositis; pedicellis ca. 5 mm. longis, glabris basi bracteis iis brevioribus tomentosis suffultis; involucris rubris ca. 7 mm. longis, labio anteriori ad basim usque fisso, lobis obtusis: lobis lateralibus anguste oblongis fere omnino liberis; appendice sacciformi, lobo integro, intus glandulis 6 gerenti; pedicellis antherarum stylique glabris; stylo apice trifido. Fructus deest.

Collected in the state of Vera Cruz. No. 8885. Type, Herb. Univ. Calif. No. 218896.

Cormonema multiflorum sp. nov.

Ramis glabris plerumque ramulis 1–10 cm. longis instructis: foliis late ovatis, glabris, basi cuneatis, apice obtusis, margine integris 2–4.5 cm. longis, 1.5–3.5 cm. latis; petiolis ca. 5 mm. longis, brunneo-

puberulis: floribus numerosis ad axillas foliorum et ramulorum fasciculatis, pedicellis ca. 2 mm. longis brunneo-puberulis; calycis lobis 5, brunneo-puberulis. Fructus deest.

The inflorescence is mainly in the axils of the somewhat crowded leaves of the short branches. The leaves have a different shape from those of *C. spinulosum* of Brazil, to which species this plant is near. The glands are distant from the petiole about 3 mm. Collected near Remudadero, Vera Cruz. No. 8863. Type, Herb. Univ. Calif. No. 218874.

Triumfetta dioica sp. nov.

Frutescens dioica: caulibus ca. 3 dm. altis dense hirsutis: foliis late ovatis, acuminatis, basi cordatis, margine serratis, supra stellato-hirsutis viridibus, subtus dense stellatis incanis, ca. 8 cm. longis, 7 cm. latis; petiolis 3.5 cm. longis hirsutis: inflorescentia fasciculati-cymulosa; calycis lobis 3.5 mm. longis extus hirsutis apice breviter fornicatis; petalis 5 ut videtur siccatis pallide flavis 1.5 mm. longis; stylo filiformi, stigmate breviter 2-dentato: fructu juveni setoso.

Staminate specimens were not collected. Collected near Hacienda Monserrate, Chiapas. No. 9256. Type, Herb. Univ. Calif. No. 223429.

Turnera violacea sp. nov.

Fruticosa: caulibus juvenibus glanduloso-pubescentibus, 10–20 cm. longis: foliis oblongo-lanceolatis, utrinque obscure puberulis, subtus pallidioribus, basi in petiolum longum marginatum angustatis, margine serratis sepius revolutis, prope basim biglandulosis, usque ad 6 cm. longis, 4 mm. latis: floribus prope axillas foliorum superiorum solitariis; petalis violaceis, acutis, ca. 1.3 cm. longis, 6 mm. latis; calyce ca. 1.5 cm. longo, lobis lanceolatis, bracteolis lineari-lanceolatis; staminibus 5, ca. 7 mm. longis; stylis 3, stigmatibus flabellatis; seminibus 3–4 obovoideis.

This proposed species with its violet flowers large for the genus is an attractive one. The leaves are crowded near the ends of the stems and usually bear two large glands at the base of the blade and often a long gland on the petiole, with other glands, sometimes, along the stems. The flowers are sessile on the petioles. The collector notes it as a rare plant, and few specimens could be obtained. The lower half of the plant is woody and the upper half herbaceous. Collected on rocky mountain slopes near Hacienda Monserrate, Chiapas. No. 9092. Type, Herb. Univ. Calif. No. 220459.

Tauschia pinetorum sp. nov.

Undique glabra: caulibus ca. 3 dm. altis paululum ramosis, prope basim folia pauca gerentibus: foliis pinnatim decompositis, lobis ultimis oblongis apice albo-acuminatis, petiolum 2 cm. longum includentibus ca. 6.5 cm. longis, 4 cm. latis: bracteis involucri involucellorumque plerumque nullis: petalis ut videtur siccatis flavis; pedunculis .05–1 cm. longis; pedicellis brevibus: fructus carpellis 5-gonis obtuse costatis ca. 4 mm. longis.

The leaves are pinnatifid like those of *Tauschia madrensis* C. & R., but are shorter and deltoid in circumscription. The minute, white, spinose tips of the lobes of the leaves are not credited to other species of the genus. Collected in pine forests of high mountains near Hacienda Monserrate, Chiapas. No. 9293. Type, Herb. Univ. Calif. No. 223468.

Ardisia chiapensis sp. nov.

Frutex: foliis alternis ovato-lanceolatis, glabris, basi in petiolum 1.3 cm. longum attenuatis, margine indistincte crenato-serratis, usque ad 10 cm. longis, 3 cm. latis: inflorescentia laxe paniculata axillari quam foliis longiori; calyce parvo profunde 4-lobato; alabastro conico, pedicellis 1–1.5 mm. longis; petalis 4 liberis, 4 mm. longis, intus puberulis; staminibus prope basim petalorum affixis, liberis, filamentis 3 mm. longis, quam antheris sagittatis acutis multo longioribus; stylo 4 mm. longo.

The leaves and flowers have, indistinctly, the usual dots and lines. Collected near Hacienda Monserrate, Chiapas. No. 9273. Type, Herb. Univ. Calif. No. 223447.

Schultesia chiapensis sp. nov.

Annua glabra: caule simplici erecto usque ad 1 dm. alto: foliis anguste lanceolatis trinerviis, majoribus 3 cm. longis, 1.5 mm. latis: floribus 1–4 caules terminantibus vel prope apicem caulis axillaribus; pedicellis 0–8 mm. longis; calyce 4 cm. longo, lobis 4 lineari-lanceolatis corollae tubum 6 mm. longum fere aequantibus dorso valde alatis alis papyraceis reticulatis; corolla infundibuliformi lobis 4; antheris versitalibus: stigmatis laminis 2 patentibus: capsula fere sessili.

The color of the corolla seems to have been light blue. The specimens in crowded masses indicate that the living plant grew covering the ground. Collected at Jalisco, Chiapas, in wet localities of meadows. No. 9158. Type, Herb. Univ. Calif. No. 220402.

Vincetoxicum? tortum sp. nov.

Volubile: caulibus paululum hirsutis: foliis glabris, superioribus alternantibus, inferioribus oppositis latioribus, ovato-acuminatis basi profunde cordatis, usque ad 11 cm. longis, 8 cm. latis; petiolis glabris, ca. 4.5 cm. longis: cymis axillaribus, laxe florentibus; pedunculis glabris 3–5 cm. longis ca. 6-floris; pedicellis 0.5–1 cm. longis: corolla alabastro ut videtur siccata flavida, valde contorta, deinde explanata fuscaque: sepalis ca. 1 mm. longis, ovato-lanceolatis intus glandulis paucis praeditis; corolla fere usque ad basim 5-lobata, lobis anguste lineari-lanceolatis, margine hirsuto-ciliatus, ca. 1.5 cm. longis; corona basi columnae affixa, 5-lobata, intus hirsuta, columnae brevi aequali; stigmate vertice depresso apiculo nullo; pollinio in quoque loculo solitario, horizontali. Folliculi non suppetunt.

This plant is a vigorous climber. The lower opposite leaves are much broader and less acuminate than the alternate upper ones. The column is very short, so the anthers and stigma appear to be sessile. The gynostegium seems to be that of *Gonolobus* as given by Bentham and Hooker, but the long, conical, contorted bud of the corolla, and the alternate leaves are peculiar. Collected at Santa Lucrecia, Vera Cruz. No. 9012. Type, Herb. Univ. Calif. No. 220312.

Vincetoxicum propinquum sp. nov.

Volubile: caulibus dense retrorsum pubescentibus: foliis ovato-acuminatis basi cordatis sinu ca. 3 mm. lato, supra paulo breviter pubescentibus, subtus pubescentibus ca. 5 cm. longis, 2.7 cm. latis; petiolis ca. 2 cm. longis, pubescentibus: floribus 1–2-cymosis pedunculo ca. 1 cm. longo pubescenti plerumque flores 2 gerenti; pedicellis ca. 3 cm. longis, pubescentibus; calyce profunde lobato lobis ovato-acuminatis ca. 7 mm. longis, breviter ciliatis extus pubescentibus; corollae tubo ca. 3 mm. longo; corona duplici, exteriori annulata lobata pubescenti prope basim corollae affixa, interiori crassa rugosa glabra; columna ca. 2.5 mm. longa; stigmate vertice depresso valde angulato.

This is near *Gonolobus uniflorus* H. B. K. but differs from the description in having retrorsely pubescent stems, a double corona, and other minor characters. Collected on mountains near Hacienda Monserrate, Chiapas. No. 9079. Type, Herb. Univ. Calif. No. 220312.

Ditassa mexicana sp. nov.

Caulibus glabris: foliis oblongo-ovatis acuminatis, supra venis prominentibus utrinquesecus ca. 12, glabris usque ad 4 cm. longis, 1.7 cm. latis; petiolis ca. 5 mm. longis: umbellis axillaribus 4–8-floris; pedunculis brevibus breviter multibracteatis; pedicellis 2–4 cm. longis: calyce 5-fido lobis ovatis; corolla 3.5 mm. longa quam calyce triplo longiori profunde 5-loba; lobis oblongis acutis prope margines breviter albo-pubescentibus; columna brevi; stigmate vertice convexo; corona

duplici basi columnae affixa, squamis exterioribus ovato-acuminatis stigmata superantibus, interioribus oblongis brevioribus. Fructus deest.

This plant resembles a broad leaved *Melastelma*. The only important character different from that genus is the double corona. Collected near Hacienda Monserrate, Chiapas. No. 9167. Type, Herb. Univ. Calif. No. 220412.

Scutellaria vitifolia sp. nov.

Herbacea: caulibus puberulis interdum paulo ramosis, ca. 20 cm. altis: foliis late ovatis, acuminatis, basi cordatis vel cuneatis, margine grosse crenato-serratis, subtus ad venas breviter hirsutulis, supra pilis paucis brevibus praeditis, usque ad 9 cm. longis, 8 cm. latis; petiolis puberulis 4–5 cm. longis: inflorescentia racemosa; pedunculis axillaribus vel terminalibus puberulis, 2–4 cm. longis; rhachibus florum 4–5 cm. longis puberulis usque ad 25-floris; floribus alternantibus pedicellis ca. 2 mm. longis quam bracteis lineari-lanceolatis longioribus calyce demum glabro; corolla 8 mm. longa breviter puberulihirsuta, tubo pallido, labiis purpureis; staminibus breviter exsertis: seminibus glabris tuberculosis.

Collected in moist, rocky, shaded localities of mountains near Jalisco, Chiapas. No. 9207. Type, Herb. Univ. Calif. No. 220509.

Salvia chiapensis sp. nov.

Fruticulus ramosus: ramis brunneis junioribus paulo pubescentibus: foliis discoloribus ovato-lanceolatis serratis basi longe cuneatis, supra venis albescentibus notatis, subtus venis prominentibus puberulis, ca. 6.5 cm. longis, 2 cm. latis; petiolis usque ad 1.5 cm. longis; racemis simplicibus axillaribus vel terminalibus 4–8 cm. longis; pedunculis ca. 2 cm. longis; pedicellis 2–3 mm. longis, glabris; bracteis ovato-acuminatis breviter ciliatis quam calyce brevioribus deciduis; calyce glabro, labio superiore integro, lobis labii inferiori acutis; verticillis approximatis usque ad 8-floris; corolla 8 mm. longa calyce duplo longiori, labiis subaequalibus extus molliter pubescentibus; staminibus inclusis; stylo exserto barbato.

From the dried specimens the color of the flowers cannot be determined with certainty, but were probably white. The spikes are densely flowered. Collected on mountains near Jalisco, Chiapas. No. 9208. Type, Herb. Univ. Calif. No. 220510.

Bouvardia Purpusii sp. nov.

Suffruticosa: caulibus pubescentibus plerumque striatis; internodiis ca. 3.5 cm. longis; foliis oppositis ovato-acutis supra breviter villosis subtus dense villosis pallidioribus basi in petiolum albovillosum ca. 4 mm. longum attenuatis, margine scabridis, 3–3.5 cm. longis, 2–5 mm. latis; stipulis albo-villosis aristis 1–2 instructis: in-

florescentiis caules terminantibus vel ad axillas superas 2–6-cymosis; pedicellis brevibus albo-villosis; tubo calycis brevi lobis 4 linearilanceolatis longitudine inaequalibus albo-villosis 3–5 mm. longis; corolla hypocrateriformi ut videtur siccata rosea ca. 4.5 cm. longa, tubo ca. 1 mm. lato extus plus minusve villoso, lobis anguste ovatis intus villosis, 1.9 cm. longis; antheris inclusis, filamentis brevibus; stylo exserto 5.5 cm. longo ramis ca. 5.5 mm. longis.

There is no suggestion of a bush about this handsome species. No. 9252 seems to be a glabrous broader leaved form of the same species. Collected near Hacienda Monserrate. No. 9251. Type, Herb. Univ. Calif. No. 223423.

Guettarda insularis sp. nov.

Frutex: foliis late ovatis, acutis, 3–6 cm. longis, 2–4 cm. latis, subtus venis prominentibus, utrinque deinde glabris; petiolis usque ad 1 cm. longis; stipulis lanceolatis: cymis 1–4 prope ad finem ramulorum, pedunculis ca. 4 mm. longis: calycis limbo tubuloso-campanulato, margine undulato, puberulo, ca. 3 mm. longo; corollae tubo ca. 7 mm. longo, adpresse pubescenti, superne paulo ampliato; lobis limbi 5, oblongis, ca. 2.5 mm. longis; staminibus apicibus paulo exsertis; stylo minute 2-lobo. Fructus deest.

Collected by A. W. Anthony, No. 377, and F. E. Barkelew, No. 179, on Socorro Island of the Revillagigedo group, Mexico. Type, Herb. Univ. Calif. No. 102472.

Borreria radicosa sp. nov.

Fruticosa patenter ramosa verisimiliter procumbens: caulibus ca. 2.5 cm. longis tetragonis, angulis retrorsum scabro-muricatis; ramis inferioribus radicibusque dense fibrato-radicatis: foliis oppositis ad axillas ramis brevissimis foliatisque instructis, utrinque glabris margine scabridis lanceolatis basi angustatis, ca. 1.7 cm. longis, 2 mm. latis; stipulis glabris setis rigidis vaginam aequantibus; internodiis 1–2 cm. longis: floribus in capitulis caules terminantibus vel verticillis axillaribus; capitulis foliis 4 involucratis interdum ad folia supera sessilibus involucra 6-foliata simulantibus: fructibus glabris oblongis dentibus 2 corollam albam aequantibus coronatis; seminibus laevibus.

This proposed species differs from *B. podocephala* in manner of branching, its stem with scabrid angles, its dense fibrous rootlets of the lower part of the stem and branches, and in other characters. The plant is sprinkled with adhering sand. Collected near Jalisco, Chiapas, growing in sand. No. 9223. Type, Herb. Univ. Calif. No. 223392.

Borreria auriculata sp. nov.

Erecta ramosa: caulibus obscure tetragonis scabridis ca. 3 dm. altis: foliis anguste ovato-lanceolatis basi in petiolum breve attenuatis utrinque scabridis, oppositis usque ad 5 cm. longis, 8 mm. latis; stipularum setis quam vaginam triplo longioribus: capitulis plerumque caules ramosque terminantibus; involucri foliis 4 ad folia suprema sessilibus, lanceolatis basi late auriculatis; calyce 4-dentato dentibus ovato-acutis ciliatis; corolla alba infundibuliformi ca. 25 mm. longa dentes calycis superanti, tubo gracili, lobis ciliatis.

The specimens are young and have no mature fruit. The glomerules of flowers terminating the stems and branches appear to have a 6-foliate involucre, but they are sessile between two lanceolate leaves connected by setiferous stipules. Collected in moist rocky meadows near Jalisco, Chiapas. No. 9218. Type, Herb. Univ. Calif. No. 22338.

Borreria chiapensis sp. nov.

Erecta, ramosa, annua: caulibus 4-sulcatis, glabris, 4–5 dm. altis: foliis oblongo-lanceolatis basi in petiolum angustatis, penniveniis supra paulo scabridis, subtus ad venas paululum scabridis, margine hispidis, usque ad 9 cm. longis, 8–15 mm. latis; stipulis cum petiolis in vaginam setosam connatis, setis ramosis quam vaginis glabris longioribus: capitulis ramos caulesque terminantibus rariter axillaribus, foliolis 4 inaequalibus ca. 3.5 cm. longis involucratis; calycis dentibus 4 lanceolatis basi setosis; corolla alba calycem paulum superanti tubo gracili fauce ampliata; stylis ramis 2 brevibus cum antheris breviter exsertis.

The leaves are longer than the internodes. The intervals between the grooves of the stem are curved: they cannot be described as quadrangular. The setae of the stipules are narrowly lanceolate and the margins ciliate. Collected in pine forests near Hacienda Monserrate, Chiapas. No. 9216. Type, Herb. Univ. Calif. No. 223384.

Borreria arenicola sp. nov.

E radice lignosa multicaulis: caulibus prostratis, tetragonis, glabris, ramosis, paulo alatis, ca. 12 cm. longis: foliis verticillatis, anguste lineari-ovatis, prope basin angustatis, apicibus acutis, glabris, ca. 9 mm. longis, medio ca. 3 mm. latis; setis stipularum vagina brevioribus: capitibus terminalibus axillaribusque foliis 4 involucratis, floribus parvis: capsulis oblongis dentibus 2 brevibus coronatis; fructu 2-cocco, coccis 1-spermis; semine ca. 3 mm. longo paulo rugoso.

Collected in a sandy arroyo near Jalisco, Chiapas. No. 8968. Type, Herb. Univ. Calif. No. 220266.

Borreria heterophylla sp. nov.

E radice perenni multicaulis: caulibus ramosis, acute tetragonis, angulis scabridis, ca. 5 cm. longis: foliis ovato-acuminatis, ca. 1 cm. longis, nunc 8 mm. latis prope basim angustatis, nunc 2 mm. latis basi lata sessilibus, glabris; setis stipularum ca. 3 mm. longis, quam vagina multo longioribus: capitibus paucifloris terminalibus axillaribusque, foliis inaequalibus ca. 6 involucratis, foliis majoribus pinnato-venosis: floribus parvis; capsula calycis dentibus deltoideo-lanceolatis 3 coronata; semine ca. 1 mm. longo.

The long conspicuous bristles of the stipules are characteristic of this species. Collected with the preceding species in a sandy arroyo near Jalisco, Chiapas. No. 8969. Type, Herb. Univ. Calif. No. 220267.

Diodia pulchella sp. nov.

E radice lignosa multicaulis: caulibus gracilibus paulo ramosis tetragonis pubescentibus cum pilis intermixtis, usque ad 6 dm. longis: foliis lanceolatis apice setiferis utrinque scabridis subtus ad costam hirsutis margine revolutis serrulato-scabris, 1.5 cm. longis, 3 mm. latis; stipulis ca. 2 mm. longis, hirsutulis, setis 8 mm. longis: verticillis 2–3-floris; calycis dentibus inaequalibus subulatis: corolla infundibuliformi 1 cm. longa, lobis ovato-acutis ut videtur siccatis lilacinis; stylo exserto ramis 2 brevibus; stigmatibus capitatis.

The flowers of this species are large for the genus. The slender elongated stems must have been prostrate or supported by other plants. Collected near Hacienda Monserrate, Chiapas. No. 9221. Type, Herb. Univ. Calif. No. 223390.

Marsypianthes arenosa sp. nov.

Herbacea, ramosa, undique viscoso-pubescens, arena adhaerente, sparsa: foliis ovatis, ca. 3 cm. longis, 1.3 cm. latis, apice acutis, basi cuneatis, margine dentatis; petiolis 2–3 mm. longis: capitulis axillaribus, versus ad ramorum apices congestis spicam formantibus; pedunculis usque ad 7 mm. longis; calyce late campanulato, 5-dentato, demum explanato; nuculis brunneis facie interiore concavo-cymbiformi, margine involutis, laceratis. Flores desunt.

The specimens do not show the habit of the plant, but the sand adhering to the stems, leaves, and calyces indicates that it is of prostrate habit. Collected near Jalisco, Chiapas. No. 8988. Type, Herb. Univ. Calif. No. 220282.

Conyza chiapensis sp. nov.

Suffrutescens, prope basim ramosa, ca. 16 cm. alta; ramis striatis, inferne pubescentibus, superne villosis: foliis ovato-lanceolatis, sessilibus, utrinque hirtellis, basi angustatis, apice acuminatis, margine integris vel dentatis, usque ad 2 cm. longis, 7 mm. latis: floribus in paniculis terminalibus numerosis; floribus femineis plerumque paucis vel nullis, corollis filiformibus, stylis longe exsertis ramis linearibus; floribus hermaphroditis fertilibus stylis truncatis; involucri squamis 4–5-seriatis, villosis, interioribus lineari-lanceolatis, ca. 5 mm. longis; pappi setis quam involucro brevioribus albis: achaeniis glabris.

Most of the heads bear only hermaphrodite corollas. The whole plant is very villous or hirsute, the leaves are somewhat crowded, and the panicle is leafy or bracteate. Collected in a sandy arroyo near Jalisco, Chiapas. No. 8987. Type, Herb. Univ. Calif. No. 220280.

Calea Purpusii sp. nov.

Eradiata: caulibus ca. 4 dm. longis, inferne glabris superne paulo pubescentibus: foliis ovato-acutis parum dentatis, subtus hirtis paucis praeditis, supra scabridis, usque ad 4.5 cm. longis, 1–6 cm. latis, sessilibus: inflorescentia caules longos terminanti; cymis pedunculis usque ad 4 cm. longis vel sessilibus ebracteatis; capitulis ca. 5 mm. longis, involucrorum squamis flavidis inaequalibus striatis apice obtusis; pappi squamis 7–8, oblongis apice fimbriatis, ca. 0.5 mm. longis; achaeniis ca. 1 mm. longis.

Most of the leaves are around the lower part of the plant with only a few oblong bracts on the upper part. The stems are not woody. Collected in pine forests on high mountains near Hacienda Monserrate, Chiapas. No. 9103. Type, Herb. Univ. Calif. No. 223414.

Verbesina sylvicola sp. nov.

Suffrutescens, ramosa: ramis puberulis: foliis oppositis, ovato-lanceolatis, apice acuminatis, basi cuneatis, margine denticulatis, supra scabro-hirsutulis, subtus hirsutulis, 9–12 cm. longis, 4.5–8 cm. latis; petiolis scabro-hirsutulis, 1.5–2.5 cm. longis: inflorescentia paniculata saepe umbelliformi; pedunculis usque ad 5 cm. longis, pubescentibus; pedicellis 0.5–3 cm. longis; involucri squamis late ovatis, 4-seriatis, ca. 5 mm. longis latisque, minute ciliatis, exterioribus pubescentibus; capitulis sine radiis diametro ca. 1 cm.; radiis flavis, ca. 7 mm. longis, 2–3 mm. latis, styliferis; achaeniis ca. 4 mm. longis; alis latis, puberulis; pappi aristis 2, 3–4 mm. longis, setis brevibus intermediis.

Collected in open forests at Santa Lucrecia, Vera Cruz. No. 8997. Type, Herb. Univ. Calif. No. 220297.

Perymenium pinetorum sp. nov.

Frutex ramosus: caulibus glabris: foliis oppositis late ovatis, acutis, margine integris vel obscure serratis, utrinque scabridis, ca. 2.5 cm. longis, 1.4 cm. latis, trinerviis, nervis lateralibus paulo supra basim orientibus; petiolis ca. 4 mm. longis: capitulis corymbosis, axillaribus terminalibusque, ovato-globosis, diametro ca. 3 mm.; pedicellis 2–5 mm. longis; pedunculis 0–1 cm. longis: involucri squamis ca. 3-seriatis, inaequalibus, exterioribus ovatis, acutis, puberulis; radiis paucis, inconspicuis, angustis; disci achaeniis plerumque triquetris; pappi setis inaequalibus, numerosis.

This species is a much branched shrub bearing very many heads of flowers. The heads seem to be eradiate, and a careful search is necessary to find the rays. Collected in rocky pine forests near Hacienda Monserrate, Chiapas. No. 9072. Type, Herb. Univ. Calif. No. 220466.

Zinnia Purpusii sp. nov.

Annua: caulibus erectis interdum ramosis, paululum puberulis, ca. 2 dm. altis: foliis lanceolatis, basi rotundatis, utrinque paulo scabridis, margine tenuiter ciliatis, usque ad 2.4 cm. longis, 4 mm. latis: capitulis caules ramosque terminantibus, globosis, diametro ca. 8 mm.; pedunculis brevibus; involucri squamis glabris plerumque purpureis, 2–3-seriatis, exterioribus brevibus suborbicularibus, interioribus obtusis vel acutis; radiis aurantiacis, ca. 2.5 mm. longis latisque: radiorum achaeniis compressis, late ovatis, bidentatis, margine tenuiter serrato-ciliatis; disci floribus atro-purpureis, achaeniis eis radiorum similibus, anguste alatis, alis oblongo-sectis.

Collected near Hacienda Monserrate on rocky mountain slopes. No. 9108. Type, Herb. Univ. Calif. No. 220369.

Aspilia scabrida sp. nov.

Valde scabra, e radice lignosa crassaque multicaulis: caulibus basi lignosis, asperis, ca. 2 dm. altis: foliis ovato-lanceolatis, utrinque acutis, scabris, margine dentatis, fere sessilibus, ca. 3.4 cm. longis, 8 mm. latis: capitulis cum pedunculis asperis usque ad 8 cm. longis axillaribus terminalibusque; involucrorum squamis longitudine aequalibus, ciliatis; exterioribus ovato-acutis pilis validis hispidis, margine ciliatis; squamis interioribus purpureo-striatis; capitulis radios includentibus diametro ca. 2.3 cm.; radiis 3–4, atropurpureis; achaeniis disci obovatis, turgidis, basi squamellis duabus parvis acutis, pilis paucis adpressis praeditis, pappo cyathiformi lacerato, aristis duabus brevibus additis.

Near *Aspilia purpurea* Greenmn. which is described as hirsute pubescent throughout. Collected near Hacienda Monserrate, Chiapas. No. 9107. Type, Herb. Univ. Calif. No. 220367.

Melanthera fruticosa sp. nov.

Fruticosa, ramosa: foliis oppositis, ovatis, acuminatis, margine serratis, basi cuneatis, utrinque fere glabris, usque ad. 6.5 cm. longis, 4 cm. latis; petiolis 2 cm. longis: floribus ramos caulesque terminantibus, pedicellis 2–2.5 cm. longis; involucri squamis ovato-lanceolatis, glabris, ca. 5 mm. longis; radii floribus flavis, styliferis; receptaculo conico demum 5 mm. longo; paleis rigidis, spinoso-acuminatis flores superantibus; achaeniis breviter pilosis, pappo aristis duabus validis cum ciliis brevibus intermediis.

Collected from rocks along the road between Tuxtla Gutierrez and Jalisco, Chiapas. No. 9117. Type, Herb. Univ. Calif. No. 220420.

NEW SPECIES OF PLANTS FROM INDO-CHINA

BY

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NEW SPECIES OF PLANTS FROM INDO-CHINA

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During the past two or three years Dr. A. Petelot of the Entomological Station at Cho-Ganh, Indo-China, has submitted to me from time to time, for identification, an extensive series of botanical specimens. Among these a considerable number of species are represented that are apparently undescribed. The present paper contains the descriptions of thirteen forms which I consider to represent new species, with notes on several previously described forms that are of sufficient general interest to warrant brief discussion. The types of the new species herein described are preserved in the Herbarium of the University of California.

GRAMINEAE

Eremochloa Petelotii Merr. sp. nov.

Erecta, glabra, circiter 60 cm. alta; foliis anguste lanceolatis, tenuiter acuminatis, margine minutissime denticulatis, 15 ad 20 cm. longis, 7 ad 9 mm. latis; ligula barbata, ciliis 2 ad 3 mm. longis; inflorescentiis circiter 25 cm. longis, spicis paucis (circiter 4), 8 ad 10 cm. longis, 3 mm. latis; pedicellis sterilibus 7 ad 9 mm. longis, breviter stipitatis, acuminatis, glaberrimis, inflatis, in siccitate brunneis, quam spiculis sessilibus circiter bis longioribus, spiculis rudimentariis 0; rhachibus articulis 2.5 mm. longis, sursum incrassatis, glaberrimis; spiculis sessilibus 4.5 ad 5 mm. longis, oblongo-ellipticis, arcte adpressis; gluma I in $\frac{1}{3}$ superiore parte utrinque ala obtriangulari lata margine minutissime ciliata munita, inde late rotundata vel truncato-emarginata, in $\frac{2}{3}$ inferiore parte spinis utrinque 7 ad 9 brevis crassis antrorse curvatis 0.5 ad 1 mm. longis instructa, partibus medianis subhyalinis, tenuissime 4-nervis; gluma II lanceolata, acuminata 4 mm. longa, hyalina, 3-carinata; III et IV 3 mm. longa, hyalina, enervosa.

Indo-China, Cambodia, Campong Chnang, *Dr. A. Petelot 247*, July, 1921. In places subject to inundation.

A species allied to *Eremochloa muricata* Hack., differing in its much larger leaves, smaller spikelets, obscurely nerved first glume, and the conspicuous sterile pedicels, which are about twice as long as the sessile spikelets.

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CAPPARIDACEAE

Capparis indochinensis Merr. sp. nov.

Frutex scandens, glaber vel subglaber, ramis ramulisque purpureo-brunneis, ramulis junioribus obscure pubescentibus glabrescentibus; foliis coriaceis, oblongis, in siccitate supra olivaceis, nitidis subtus brunneis, glaberrimis, 4 ad 6 cm. longis, 2 ad 3 cm. latis, breviter acuminatis, basi obtusis ad rotundatis plerumque obscure cordatulis, nervis utrinque circiter 7, obscuris vel admodum obsoletis; petiolo 4 ad 6 mm. longo; stipulis spiniformibus brevibus, crassis, curvatis, 1.5 ad 2 mm. longis; inflorescentus axillaribus, brevibus, solitariis, paucifloris, 1 ad 1.5 cm. longis, floribus racemoso-umbellatim dispositis, pedicellis circiter 4 mm. longis; sepalis ellipticis, concavis, quam petalis paullo brevioribus, glabris; petalis oblongo-obovatis, obtusis, 5 mm. longis, deorsum ad margine ciliatis; staminibus 20, filamentis 4 ad 5 mm. longis, glabris, antheris 1.5 mm. longis; ovario glabro, breviter (1.5 mm.) stipitato, placentis binis, 2- vel 3-ovulatis.

Indo-China, Cho-Ganh, *Dr. A. Petelot 1463 (type), 1448*, September, 1923. On limestone hills.

A species well characterized by being almost entirely glabrous, as well as by its very short, few-flowered, solitary, axillary inflorescences. As the Indo-China species are arranged by Gagnepain[1] it seems to be most closely allied to *Capparis tonkinensis* Gagnep., from which, among other characters, it is at once distinguished by its very short inflorescences.

EUPHORBIACEAE

Glochidion triloculare Merr. sp. nov. § **Euglochidion**

Frutex vel arbor parva, ramis teretibus, brunneis, glabris, ramulis tenuibus, leviter ciliatis; foliis chartaceis, subolivaceis, utrinque concoloribus, nitidis, oblongis ad oblongo-ovatis, 6 ad 9 cm. longis, 2 ad 3.5 cm. latis, breviter acuminatis apiculatisque, basi subacutis ad subrotundatis, equilateralibus ad perspicue inaequilateralibus, supra glabris vel costa deorsum obscure pubescentibus, subtus ad costa nervisque leviter ciliatis, nervis utrinque circiter 6, curvato-anastomosantibus, subtus distinctis; petiolo 5 ad 6 mm. longo. Floribus ♂ paucis, pedicellis 5 mm. longis, cinereo-ciliatis; sepalis oblongis, 2 ad 2.5 mm. longis, extus pubescentibus, interioribus minoribus; antheris 5, connatis, 2 ad 2.5 mm. longis; floribus ♀ numerosis, fasciculatis, sessilibus, sepalis 6, elliptico-ovatis, liberis vel subliberis, 1.5 mm. longis, pubescentibus, alternantibus minoribus; ovario subgloboso, 3-loculare, dense pubescente; columna stylaris quam ovario brevioribus, glabra, crassa, vix 1 mm. longa, basi haud constricta, subcylindrica, brevissime lobata.

[1] Gagnepain, F., Capparidacées, *in* Lecomte, Flore générale de l'Indo-Chine, vol. 1, 1908, pp. 181–196.

Indo-China, Cho-Ganh, *Dr. A. Petelot 1479*, October, 1923. In thickets.

Within the section, a species strongly characterized by its densely pubescent, 3-celled ovaries.

Strophioblachia fimbricalyx Boerl. Handl.

Fl. Nederl. Ind., vol. 3, part 1, 1900, pp. 236, 284.
Strophioblachia glandulosa Pax in Engl. Pflanzenreich, vol. 47, 1911, p. 36, f. 10.

Indo-China, Cho-Ganh, *Dr. A. Petelot 832, 923*, December, 1922, and June, 1923. On limestone hills.

A monotypic genus originally described from Celebes, but now also known from Luzon, Palawan, Panay, Mindanao, and Bongao in the Philippines.

Trigonostemon Petelotii Merr. sp. nov. § **Dichotomae** sect. nov.

Frutex vel arbor parva, partibus junioribus leviter adpresse hirsutis, ramis glabris, lenticellatis, subpurpureis; foliis membranaceis vel chartaceis, oblongo-lanceolatis ad oblongo-oblanceolatis, 3 ad 10 cm. longis, 1.5 ad 3.5 cm. latis, olivaceis, obtuse acuminatis, margine distanter glanduloso-denticulatis, basi acutis ad obtusis, 3-nerviis, nervis lateralibus utrinque 3 vel 4, tenuibus, distantibus, haud perspicuis, supra minute albido-verruculosis, subtus ad costa nervisque leviter adpresse hirsutis; petiolo 5 ad 18 mm. longo; inflorescentiis ♂ axillaribus, 3 ad 6 cm. longis, pedunculatis, dichotome ramosis, subcymosis, paucifloris, leviter hirsutis; sepalis inaequalibus, ellipticis ad obovatis, leviter ciliatis, haud glandulosis, majoribus 2.5 mm. longis, retusis, minoribus 1.5 ad 2 mm. longis, truncatis; petalis 5, elliptico-obovatis, rotundatis, glabris, 6 mm. longis, 3 mm. latis; filamentis columnae 1.5 mm. longae, antheris 3, brevissime stipitatis, 0.6 mm. longis, orbiculari-ellipticis, integris; disco 1 mm. diametro; floribus ♀ fructibusque ignotis.

Indo-China, Cho-Ganh, *Dr. A. Petelot 795 (type), 922*, June, 1921, and December, 1922. On limestone hills.

For this very distinct species I have proposed the new section *Dichotomae*, on account of the dichotomous, cymose, axillary staminate inflorescences and the entire anthers.

Cleistanthus longipedicellatus Merr. sp. nov. § **Pedicellati**

Frutex vel arbor parva, ramulis leviter pubescentibus exceptis glabra, ramis teretibus, lenticellatis; foliis chartaceis, olivaceis, nitidis, oblongo-ellipticis ad oblongo-lanceolatis, 7 ad 13 cm. longis, 2.5 ad 3.5 cm. latis, acutis ad distincte acuminatis, deorsum angustatis, basi

acutis vel rariter obtusis, nervis utrinque 7 ad 10, tenuibus, distinctis; petiolo 3 ad 4 mm. longo; floribus ♂ fasciculatis, axillaribus, sessilibus, 7 mm. diametro; sepalis 5, oblongo-ovatis, acutis vel acuminatis, 3.5 mm. longis, petalis minutis, vix 1 mm. longis, oblongis; disco 2 mm. diametro: floribus ♀ paucis, axillaribus, longe (3 cm.) pedicellatis, 1 ad 1.2 cm. diametro; sepalis oblongo-obovatis, 6 mm. longis, accrescentibus, persistentibus; petalis lanceolatis ad oblanceolatis, acutis, 1 mm. longis; disco 5 mm. diametro; ovario glabro, ovulis basilaribus, stylis brevibus 1.5 mm. longis.

Indo-China, Cho-Ganh, *Dr. A. Petelot 1172 (type), 1173*, October, 1923. On limestone hills.

A distinct species belonging in the section *Pedicellati*, strongly characterized by its relatively large, long pedicelled female flowers, and its persistent accrescent sepals. An allied form is apparently represented by *Petelot 867* from the same locality. The specimen is in fruit, has larger, fewer nerved, longer petioled leaves and densely pubescent branchlets. *Cleistanthus longipedicellatus* is entirely glabrous except for a few scattered hairs on the youngest branchlets.

DILLENIACEAE

Saurauia Petelotii Merr. sp. nov.

Frutex vel arbor parva, ramis glabris, atro-purpureis, ramulis, 5 mm. diametro, dense cinnamomeo-tomentosis et paleis brevibus sparsis adpressis lanceolatis vel ovato-lanceolatis 1 ad 1.5 mm. longis instructis; foliis chartaceis vel coriaceis, ellipticis, 15 ad 20 cm. longis, 9 ad 15 cm. latis, rotundatis ad breviter acuminatis, basi late rotundatis, margine breviter serrulato-setosis, supra olivaceis, glaberrimis, nitidis, subtus densissime cinnamomeo-tomentosis, costa nervisque paleis brevibus sparsis adpressis instructis, nervis utrinque circiter 25, perspicuis; petiolo 4 cm. longo, dense cinnamomeo-tomentoso, paleis adpressis instructo; inflorescentiis lateralibus e ramis vetustioribus, fasciculatis, cymosis, 3 ad 5 cm. longis, tomentosis setosisque; pedicellis circiter 1 cm. longis; sepalis late elliptico-ovatis, rotundatis, glabris, 4.5 ad 5 mm. longis; fructibus globosis vel ovoideis, glabris, sepalis aequantibus; stylis 5, circiter 5 mm. longis, basi 1.5 mm. connatis.

Indo-China, "Massif du Pia Quac," near Nam Kep, *Dr. A. Petelot 669*, July, 1922, in alluvial decomposed schist soil.

A very strongly marked species well characterized by the dense cinnamomeous tomentum on the branchlets, petioles, and lower surface of the leaves, the upper surface of the leaves being entirely glabrous.

THEACEAE

Thea Petelotii Merr. sp. nov.

Frutex vel arbor parva, glabra vel subglabra, ramis ramulisque glabris, purpureo-brunneis, circiter 3 mm. diametro; foliis oblongis ad oblongo-ellipticis, 15 ad 23 cm. longis, 5.5 ad 7 cm. latis, coriaceis, glaberrimis, in siccitate olivaceis, subopacis, subtus pallidioribus et in siccitate plerumque verruculosis, breviter acuminatis, basi late acutis ad subrotundatis, margine distanter glanduloso-crenulatis; nervis utrinque circiter 10, subtus perspicuis, distantibus, anastomosantibus; petiolo 1.4 ad 1.8 cm. longo; floribus terminalibus, solitariis vel binis, pedicellatis, circiter 6 cm. diametro, pedicellis 1 ad 1.5 cm. longis, bracteis late ovatis ad subreniformibus margine obscure ciliatis 2 ad 3 mm. longis et 3 ad 5 mm. latis sursum in sepalis transuentibus instructis; sepalis exterioribus bracteiformis, interioribus late ovatis, coriaceis, rotundatis, margine plus minusve ciliatis, 10 ad 12 mm. longis et latis; petalis circiter 12, integris, ellipticis ad oblongo-ellipticis, obtusis, 2.5 ad 3 cm. longis, circiter 1.5 cm. latis, margine ciliatis excepta glabris, in siccitate verruculosis; staminibus ∞, filamentis circiter 1.8 cm. longis, glabris, interioribus liberis, exterioribus omnibus usque ad $\frac{1}{2}$ connatis; antheris 4 mm. longis; ovario glabro, 3-loculare; stylis 3, glabris.

Indo-China "Massif du Tam Dao," *Dr. A. Petelot 848*, February, 1923, altitude 900 m.

A species apparently allied to *Thea tonkinensis* Pitard but differing in its larger, very shortly acuminate leaves, the nerves projecting on the lower surface; longer petioles; the bracts and sepals merely ciliate on their margins, otherwise glabrous; the ovary and styles glabrous.

FLACOURTIACEAE

Homalium myriandrum Merr. sp. nov.

Arbor, floribus exceptis glaberrima, ramis teretibus, ramulis tenuibus; foliis coriaceis, oblongo-ellipticis, utrinque nitidis, breviter obtuseque acuminatis, basi acutis ad rotundatis, integris vel obscure distanter glanduloso-crenulatis, 6 ad 9 cm. longis, 2.5 ad 4.5 cm. latis, nervis utrinque circiter 8, distinctis, curvatis, anastomosantibus; petiolo 4 ad 5 mm. longo; racemis axillaribus, solitariis, foliis subaequantibus; floribus numerosis, 9- vel 10-meris, circiter 8 mm. diametro, pedicellis 3 mm. longis; sepalis lanceolatis, acuminatis, glabris vel subglabris, 3 mm. longis; petalis oblongis, 4 mm. longis, intus dense cinereo-villosis; staminibus circiter 100, filamentis glabris, 3 mm. longis; ovario pubescente, stylis 4, tenuibus, 1.5 mm. longis.

Indo-China, Cho-Ganh, *Dr. A. Petelot 960 (type)*, *1460*, June and September, 1923. On limestone hills.

A species very strongly marked by its 9- or 10-numerous flowers and its very numerous stamens, about ten stamens opposite each petal.

ARALIACEAE

Schefflera Petelotii Merr. sp. nov. § **Euschefflera, Heptapleurum**

Frutex plus minusve stellato-tomentosus; ramulis circiter 1 cm. diametro, dense stellato- vel breviter plumoso-tomentosis; foliis palmatim 5-foliolatis; petiolo circiter 20 cm. longo, junioribus plus minusve tomentoso, vetustioribus glabro, basi leviter dilatato; stipulis oblongo-lanceolatis, 1.5 cm. longis; foliolis elliptico-ovatis, subcoriaceis, pallide olivaceis, 12 ad 15 cm. longis, 8 ad 10 cm. latis, integris, breviter obtuse acuminatis, basi late rotundatis, supra glabris, nitidis, subtus stellato-tomentosis, nervis utrinque circiter 7, perspicuis petiolulis 2 ad 4 cm. longis; inflorescentiis terminalibus, plus minusve stellato-tomentosis, ramis primariis circiter 10, usque ad 12 cm. longis, racemose dispositis, rhachibus crassis, 3 ad 4 cm. longis, bracteis subpersistentibus, lanceolatis, coriaceis, 3 cm. longis, extus dense pallide tomentosis, intus glabris; floribus 5-meris, umbellatis, umbellulis 5- ad 7-floris, in ramis primariis racemose dispositis, pedunculis 8 ad 13 mm. longis, stellato-tomentosis, pedicellis 3 ad 5 mm. longis, parce stellato-tomentosis; calycis turbinatis, circiter 2 mm. diametro, parcissime stellato-tomentosis; petalis 5, circiter 1 mm. longis, extus parce stellato-tomentosis; ovario 5-loculare, stylis 0.

Indo-China, Cho-Ganh, *Dr. A. Petelot 942*, June, 1923. On limestone hills.

A remarkably distinct species not at all closely allied to any of the nine species known from Indo-China. It is well characterized by its stellate, or in places, plumose indumentum, together with its vegetative and inflorescence characters. Each primary branch of the inflorescence bears about 20 umbels, each umbel being subtended by an oblong-lanceolate, 5 mm. long bract.

SYMPLOCACEAE

Symplocos myriadenia Merr. sp. nov. § **Bobua, Lodhra**

Arbor parva, ramulis junioribus sepalisque ferrugineo-pubescentibus exceptis glabra, ramis teretibus, subpurpureis; foliis oblongis, subcoriaceis, oblivaceis, subtus pallidioribus, 6 ad 8 cm. longis, 2 ad 2.5 cm. latis, basi acutis, apice perspicue acute acuminatis, margine glanduloso-serratis; petiolo 5 ad 7 mm. longo supra glandulis parvis 18 ad 24 in series duas dispositis praeditis, nervis utrinque circiter 6, supra cum costa valde impressis, subtus valde perspicuis, arcuato-anastomosantibus; floribus sessilibus, axillaribus et in axillis defoliatis, fasciculis usque ad 20-floris; calycis 2 mm. diametro, tubo glabro, lobis 5, orbiculari-ovatis, 1 mm. diametro, ferrugineo-ciliatis; petalis 5, liberis, ellipticis, 3 mm. longis, staminibus circiter 22, liberis vel subliberis, filamentis glabris, 4 ad 5 mm. longis; stylis glabris, 4 mm. longis; ovario 3-loculare.

Indo-China, "Massif du Tam Dao," *A. Petelot 1518*, October, 1923.

A species manifestly closely allied to *Symplocos adenopus* Hance of southern China, differing in its much smaller leaves, fewer petiolar glands, shorter petioles, the nerves conspicuously impressed on the upper surface, etc.

Symplocos Petelotii Merr. sp. nov. § **Bobua, Lodhra**

Arbor parva, ramis teretibus, glabris, castaneo-purpureis, ramulis junioribus perspicue ferrugineo-pubescentibus; foliis coriaceis, ellipticis, glabris vel subtus ad costa leviter ciliatis, integris vel obscurissime glanduloso-crenulatis, flavido-olivaceis, nitidis, utrinque late rotundatis, 5 ad 8 cm. longis, 3 ad 4.5 cm. latis, costa supra leviter impressa, nervis utrinque 5 ad 7, perspicuis, supra planis, subtus prominentibus, anastomosantibus; petiolo glabro, 5 ad 7 mm. longo; inflorescentiis axillaribus, ferrugineo-pubescentibus, stricte racemosis, solitariis, 15- ad 20-floris, 4 ad 6 cm. longis; floribus luteis, circiter 1.5 cm. diametro, pedicellis 3 mm. longis, apice bibracteolatis, bracteolis ovatis, acutis, pubescentibus, 2.5 mm. longis; calycis circiter 5.5 mm. diametro, tubo 2 mm. longo, glabro, lobis 5, inaequalibus, elliptico-ovatis, rotundatis, exterioribus distincte pubescentibus, interioribus subglabris; petalis 5, liberis, glabris, ellipticis, rotundatis, 6 ad 6.5 mm. longis, 4 mm. latis; staminibus ∞, filamentis liberis, glabris, 3 ad mm. longis; ovario 3-loculare; stylis glabris, 4 mm. longis.

Indo-China, Cho-Ganh, *Dr. A. Petelot 765*, November, 1921, in argillaceo-calcareous soil.

A species well characterized by its coriaceous, elliptic, entire, rounded leaves; by being glabrous or nearly so except for the younger branchlets and inflorescences; and by its bibracteolate not tribracteolate flowers. It probably belongs in the group with *Symplocos elegans* Thwaites.

OLEACEAE

Jasminum longisepalum Merr. sp. nov.

Frutex scandens ramulis junioribus puberulis sepalisque dense cinereo-pubescentibus exceptis glaber; ramis teretibus, laevis, olivaceis vel purpureis, ramulis circiter 2 mm. diametro; foliis simplicibus, ovatis ad oblongo-ovatis, chartaceis ad subcoriaceis, 3 ad 8 cm. longis, 2 ad 4 cm. latis, olivaceis, nitidis, glaberrimis, acute acuminatis, basi rotundatis, 5-plinerviis, nervis tenuibus, distinctis, nervis lateralibus paucis; petiolo 1 ad 1.5 cm. longo; inflorescentiis terminalibus axillaribusque, pedunculatis, cinereo-pubescentibus, floribus numerosis, confertis, plerumque in triadibus dispositis, pedicellatis, calycis tubo 2 ad 3 mm. longo, lobis plerumque 7, linearis, 1.5 ad 3 cm. longis, dense cinereo-pubescentibus; corolla glabra, tubo 2.5 cm. longo, lobis plerumque 7, oblongo-ovatis, acute acuminatis, circiter 1 cm. longis; antheris oblongis, 5.5 mm. longis.

Indo-China, Cho-Ganh, *Dr. A. Petelot 773, 973 (type)*, July, 1923. On limestone hills.

A remarkable species strongly characterized by its very long, slender, densely cinereous-pubescent calyx lobes which attain a length of 3 cm. In vegetative characters it resembles *Jasminum bifarium* Wall. and manifestly belongs in the same general group as that species.

Jasminum nervosum Lour.

Fl. Cochinch. 20. 1790.

Indo-China, Cho-Ganh, *Dr. A. Petelot 907*, June, 1923. In hedges.

The specimen matches material collected by Mr. McClure at Hue, where Loureiro lived while in Cochin China, and agrees closely with the original description except that the leaves are simple, not pinnate. I explain the discrepancy on the assumption that Loureiro misinterpreted the simple distichous leaves or that he deliberately described the leaves as imparipinnate to bring his description into conformity with the other Linnean species of the genus known to and described by him. It is the same as the form figured by Ker, Bot. Reg., vol. 7, 1821, t. 521, as *Jasminum angustifolium* (non. Vahl) var. *laurifolium* Ker, which in turn is the same as *Jasminum laurifolium* Roxb. Loureiro's specific name takes precedence. India to southern China and Indo-China.

VERBENACEAE

Premna acuminatissima Merr. sp. nov.

Frutex vel arbor parva, partibus junioribus leviter pubescentibus; ramis glabris, pallidis, ramulis, teretibus, rubro-brunneis, junioribus leviter pubescentibus; foliis ovatis ad elliptico-ovatis, perspicue longe acuminatis apiculatisque, basi subacutis ad rotundatis, chartaceis, olivaceis, nitidis, 5 ad 9 cm. longis, 2.5 ad 4 cm. latis, punctatis, supra glaberrimis, subtus glabris vel ad costa nervisque obscure pubescentibus, nervis utrinque plerumque 3, perspicuis, subadscendentibus, anastomosantibus; petiolo circiter 1 cm. longo, leviter pubescente; inflorescentiis terminalibus, paniculatis, laxis, anguste pyramidatis, 6 ad 8 cm. longis, obscure pubescentibus; floribus 5 ad 6 mm. longis, extus puberulis, pedicellis 2 mm. longis, bracteis bracteolisque lanceolatis, acuminatis, bracteis 2 mm. longis, bracteolis 1 mm. longis; calycis cupulatis, 2.5 mm. longis, obscurrissime 2-labiatis, subaequaliter 5-dentatis, dentibus brevibus, acutis; corollae tubo 2 ad 2.5 mm. longo, subaequaliter 4-lobato, lobis ovato-rotundatis, 2.5 ad 3 mm. diametro; stylis filamentisque 3 mm. longis, glabris.

Indo-China, Cho-Ganh, *Dr. A. Petelot 1431*, September, 1923. On limestone hills.

A species strongly characterized by its slenderly acuminate, nearly glabrous leaves and its narrowly pyramidal panicles. The acumen on the larger leaves is frequently 1.5 to 2 cm. in length.

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ERRATA

Page 393, line 15. *For* albido *read* albidis.
Page 393, line 20. *For* carpostomi *read* carpostomio.
Page 394, line 27.) *For* **Gonmiophyllum** *read* **Gonimophyllum.**
Page 395, line 5.)
Page 394, line 31. *For* mentibus *read* nentibus.
Page 395, line 19. For *Nitrophyllum* read *Nitophyllum.*
Page 399, line 15. *For* maximate *read* maxima.
Page 399, line 19. *For* systocarpic *read* cystocarpic.
Page 397. Under "Key" expand the first two lines to:

1. Cystocarps on terminal segments only 2
1. Cystocarps marginal (or on lateral lobes only) 4
1. Cystocarps largely on the 'disk' of the frond 9

THE GENUS FUCUS ON THE PACIFIC COAST OF NORTH AMERICA

BY

NATHANIEL LYON GARDNER

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BY

TOWNSHEND STITH BRANDEGEE

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BY

ALICE M. OTTLEY

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BY

TOWNSHEND S. BRANDEGEE

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